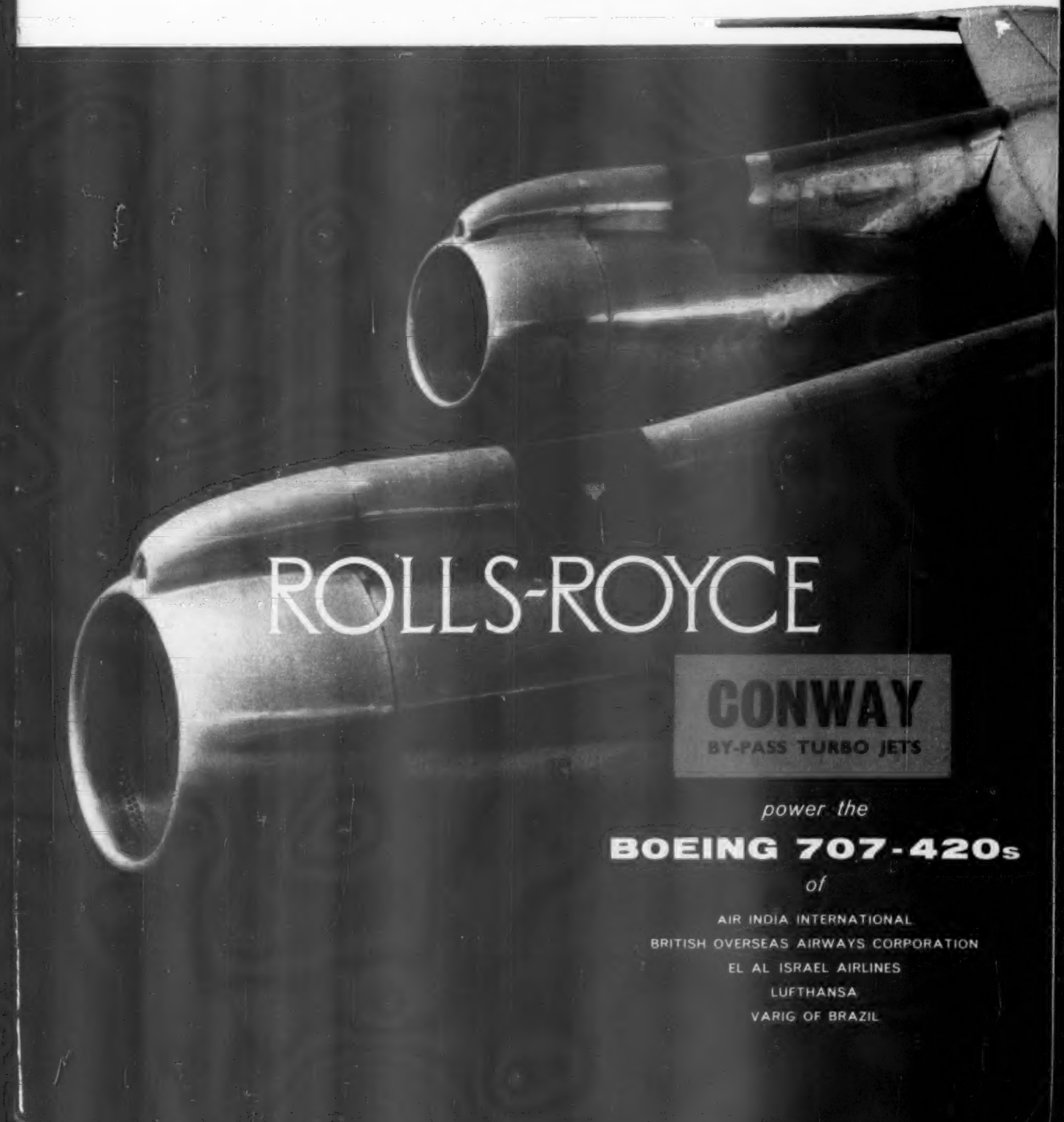
THE AEROPLANE and ASTRONAUTICS

JANUARY 6, 1961

EVERY FRIDAY
ONE SHILLING
AND SIXPENCE

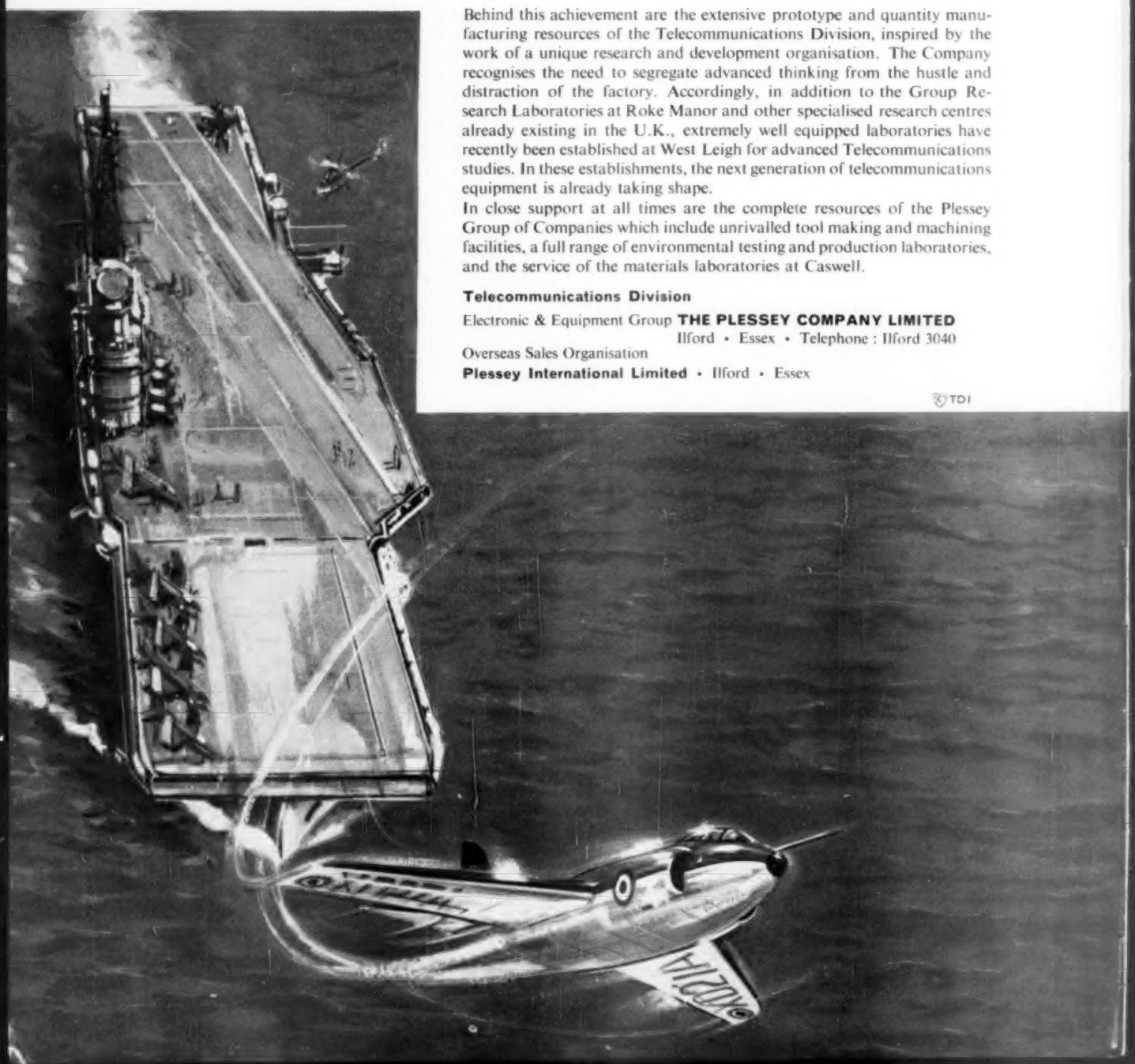


Plessey

TELECOMMUNICATIONS

'clear the air'

Plessey is everywhere, you'll find . . . in the Royal Navy for example, where strike aircraft of the Fleet keep a watching brief on the skyways and maintain contact with the help of Plessey UHF.



Behind this achievement are the extensive prototype and quantity manufacturing resources of the Telecommunications Division, inspired by the work of a unique research and development organisation. The Company recognises the need to segregate advanced thinking from the hustle and distraction of the factory. Accordingly, in addition to the Group Research Laboratories at Roke Manor and other specialised research centres already existing in the U.K., extremely well equipped laboratories have recently been established at West Leigh for advanced Telecommunications studies. In these establishments, the next generation of telecommunications equipment is already taking shape.

In close support at all times are the complete resources of the Plessey Group of Companies which include unrivalled tool making and machining facilities, a full range of environmental testing and production laboratories, and the service of the materials laboratories at Caswell.

Telecommunications Division

Electronic & Equipment Group **THE PLESSEY COMPANY LIMITED**
Ilford • Essex • Telephone : Ilford 3040

Overseas Sales Organisation
Plessey International Limited • Ilford • Essex

TDI

Aircraft serve the world...

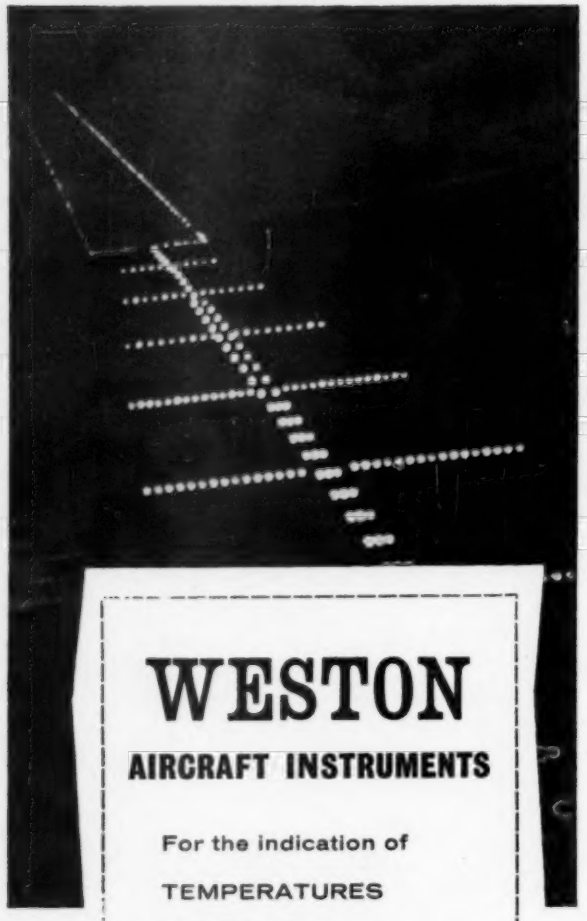
In the rural districts of many countries, aircraft form the most dependable link with civilisation. In Africa, Australia, Canada and New Zealand, outlying communities are coming to rely more and more on aircraft for their daily needs. Here a farmer guides down an Air Ambulance of the South Saskatchewan Department of Health. Photograph by the National Film Board of Canada.

CELLON serve the world's aircraft

AIRCRAFT FINISHES BY CELLON LIMITED, KINGSTON-ON-THAMES · KINGSTON 1234

CVS-951

A



WESTON

AIRCRAFT INSTRUMENTS

For the indication of

TEMPERATURES

PRESSURES

CONTROL SURFACE POSITIONS

TURBINE SPEEDS

ELECTRICAL POWER

ALSO: Navigational Aids*
Ground Test Sets
Ice Warning Systems · Relays etc.

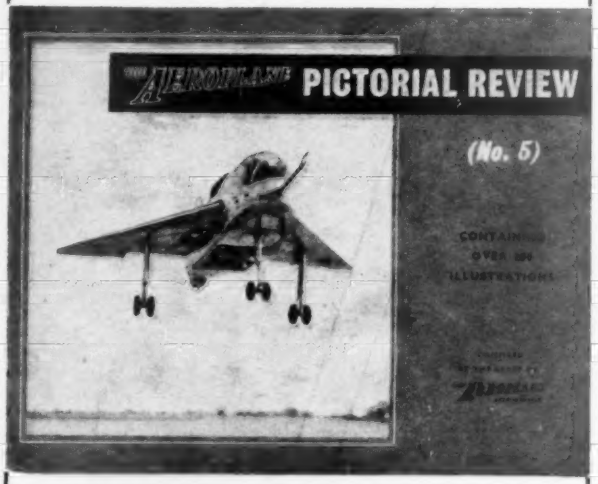
*Model S178 Hermetically sealed miniature homing indicator.

SANGAMO WESTON LIMITED
ENFIELD · MIDDLESEX

Tel: Enfield 3434 (6 lines) & 1242 (6 lines) Grams: Sanwest, Enfield.
Scottish Factory, Port Glasgow, Renfrewshire, Port Glasgow 41151.
Branches:
London · Glasgow · Manchester · Newcastle-on-Tyne
Wolverhampton · Nottingham · Bristol · Southampton

SW/81

The Aviation Picture Book of the Year



THE AEROPLANE

PICTORIAL REVIEW (No. 5)

Containing over 200 illustrations selected for their striking quality and outstanding interest the new, Fifth Edition of this popular annual forms a unique pictorial record of the year's events in aviation throughout the world.

All the latest types of military and civil aircraft, in service and under development, are featured, including VTOL and STOL designs, naval aircraft, and helicopters large and small. There is a section reviewing the latest missiles and space vehicles and others portraying the newest type of light and executive aircraft and the highlights of the 1960 Farnborough Air Show.

CONTENTS INCLUDE

New Shapes of 1960
Commercial Transport Aircraft
Light and Executive Aircraft
Missiles and Spaceflight
Fighters—Formation
Focus on Farnborough Air Display
Strategic Spearhead
For Aeronautical Development
Trainers and Transports
Rotary Wing Selection
Events of the Year

Size: 7½ x 10 in. 128 pages
Over 200 illustrations
price 12s. 6d. net
(By post 13s. 7d.)

TEMPLE PRESS

TEMPLE PRESS BOOKS:

Bowling Green Lane, London, E.C.1.

TO DATE 404 SUCCESSFUL ESCAPES

have been made using

MARTIN-BAKER EJECTION SEATS

The result of 16 years experience and more than 850 test ejections.

MARTIN-BAKER

TODAY'S
ECONOMICAL
AIR FREIGHTER

ARGOSY

HAWKER SIDDELEY AVIATION 32 Duke Street, St. James's, London, S.W.1.

THE AEROPLANE and ASTRONAUTICS

VOLUME 100 NUMBER 2568 JANUARY 6, 1961

Events on the Wing

When one is flying in a jetliner in the higher latitudes one is flying fast enough to keep up with the edge of night moving over the surface of the globe. To one contemplating such a phenomenon the idea of time as something universally fixed seems decidedly old-fashioned. And in a modern world the idea of a New Year's Day having some special significance seems definitely out of place. And in fact it is, of course, occurring in a series of steps, longitude by longitude.

Time, these days, is much easier to understand for what it really is, a never-ending stream of successive events. In that stream, now beginning to speed up again after the festivating of Christmas, there are clearly going to be a number of important aeronautical events. It will be no bad thing if one of the first is an announcement by the Government of what decisions have been taken regarding the use of Blue Streak, in collaboration with our French friends, to launch a European communications satellite.

It is already clear that closer collaboration with Europe must take place before the start of another New Year. It is likely that one of the earliest examples of such collaboration will be in the field of VTOL in which this country has done so much worth-while pioneer work.

We must hope that 1961 will see real progress made with Eurocontrol, the organization agreed upon, and now to be brought into existence, to improve air traffic control over Europe. Of course such control will be valueless unless the military are brought into it. For this reason it is to be hoped that an early event in the New Year will be the report of the Patch Committee on the co-ordination of civil and military air traffic control.

Thanks to Mr. Henry Kremer, we can be quite certain about one thing in 1961, and that will be the most concentrated attack yet made upon the problems of man-powered flight. Not only has this far-sighted manufacturer put up a prize of £5,000, but he has seen that funds are available to finance worth-while attempts to win the prize.

It is a stimulating thought for the New Year that man's oldest dream may be realized by an individual and not by a state-aided research team. There could be a moral here!

Greetings Round the World

So much has been written about the commercialization of the Christian festival of Christmas that we should like to assure the host of friends at home and abroad who sent greetings how much their good wishes were appreciated. Excepting for an inevitable oversight or two the Editor himself has read every Christmas and New Year greetings card sent to him or the editorial staff as a group, and it is remarkable how personal a scribbled message can make a printed card become. It was indeed with warm feelings that we read tributes from friends all over Europe, and from both sides of what, with some justification in those days, used to be called the Iron Curtain.

The cards came from readers of all ranks, from Air Chief Marshals in retirement to members of R.A.F. units overseas, from friends in industry and from friends in the transport business, and perhaps as warmly welcomed as any, from the rising generation.

To all those who wrote, and to those who meant to, greetings and best wishes for success in 1961—and next time will those who did not remember to do it, please put the address on.

Editor - - - THURSTAN JAMES
Deputy Editor - - F. T. MEACOCK

Founder Editor (1911-1939) *C. G. Grey*

Proprietors: TEMPLE PRESS LIMITED
Chairman and Managing Director:
ROLAND E. DANGERFIELD

Editorial, Advertisement and Publishing Offices:
BOWLING GREEN LANE, LONDON, E.C.1

Telephone: TERminus 3636
Telegrams: "Pressimus London Telex"
Telex: 23839

Annual Subscription Rate: United Kingdom £4 15 0
Overseas £5. Canada and U.S.A. $15.00

© Temple Press Limited, 1961. The proprietors will consider any written requests to reproduce articles and illustrations appearing in this journal. Comment and brief extracts which acknowledge *The Aeroplane and Astronautics* are permissible.

Matters of Moment

Skybolt Growing Pains

THERE has been so much confusion in recent reports about the Skybolt A.L.B.M. that its true position is difficult to assess. As mentioned in our last issue, a cut in Skybolt funds had been proposed for the budget year beginning Jly. 1, 1961. This fact, reported in *Aviation Week*, led to several reassurances about the missile's future. A week later, in its Dec. 26 issue, this U.S. journal had more to say about Skybolt.

A flood of official statements was triggered off by its report that work on adapting Skybolt for carriage by the Avro Vulcan had been halted and would not be resumed until British money became available. It was also stated that the entire Skybolt project at Douglas had been placed in jeopardy through a financial tangle caused by unauthorized expenditure of money to keep the programme going. As a result there had been a sharp cutback for the rest of the fiscal year, causing 30-50% of the engineers to be withdrawn from various sections of the project. Consequently some of the target dates would fall behind by up to six months. It was stated that the first guided firing had slipped by three to four months, but that flight trials with dummy missiles would be made on schedule. According to the magazine, Skybolt is unsuitable for launching by the Mach 3 B-70 bomber.

The British Embassy in Washington denied the *Aviation Week* report that adaptation of Skybolt for the Vulcan had been halted; it stated that this work was continuing and was paid for by British funds. In Britain, Avro confirm that there has been no cutback in their contract for work on adapting the Vulcan to carry Skybolt.

Following the magazine report, Washington officials said that there were sufficient funds in the new U.S. budget for Skybolt development until Jne. 30, 1962. The budget for the fiscal year from Jly. 1, 1961 to Jne. 30, 1962 will be submitted to Congress this month.

Another Washington report says that the Defense Department has not requested additional money for Skybolt because expenditure has been on a "somewhat lush scale." A senior defence official is quoted as saying "You cannot expect to continue living in the style you have become accustomed to as regards Skybolt expenditures, but you can be sure that any suggestion of serious delay as regards Skybolt development can be discounted."

A later report stated that Douglas and three Skybolt subcontractors had received assurances from the Defense Department that the development programme for this missile would go through. Officials are said to have stated that the U.S.A.F. could obtain up to $150 million for the programme, including money already spent, and that the total cost should be less.

But what nobody has said is that Skybolt production will be up to the original schedule.

Rocket Development in France

NEXT week, technical teams from Great Britain, France and other European nations will be meeting in London to examine concrete proposals for a heavy satellite launcher based on the Blue Streak. Britain is expected to provide the first

New Year Honours

A SUPPLEMENT to the *London Gazette* published on Dec. 31 contained the following civil and military New Year Honours conferred by Her Majesty the Queen.

KNIGHTHOOD

George Edward Beharrell, chairman, Dunlop Rubber Co., Ltd.; Cecil Dannatt, O.B.E., M.C., vice-chairman, A.E.I., Ltd.; Edward Roberts Lewis, chairman, The Decca Navigator Co., Ltd., and Decca Radar, Ltd.; Alfred Charles Bernard Lovell, O.B.E., Professor of Radio Astronomy, University of Manchester, director, Jodrell Bank Experimental Station.

ORDER OF THE BATH

Knight Grand Cross (Military)

Air Chief Marshal Sir Thomas G. Pike, K.C.B., C.B.E., D.F.C.

Knights Commanders (Military)

Air Marshal S. C. Elworthy, C.B., C.B.E., D.S.O., M.V.O., D.F.C., A.F.C., M.A.; Vice-Admiral L. G. Durlacher, C.B., O.B.E., D.S.C.; Acting Air Marshal A. D. Selway, C.B., D.F.C.

Companions (Military)

Air Vice-Marshal M. H. Dwyer, C.B.E.; Air Vice-Marshal G. A. M. Knight, C.B.E., Q.H.S., M.B., B.S., D.L.O.; Rear Admiral R. M. Smeeton, M.B.E.; Acting Air Vice-Marshal E. L. Colbeck-Welch, O.B.E., D.F.C.; Air Commodores F. E. Rosier, C.B.E., D.S.O.; R. G. Seymour, C.B.E.; D. F. Spotswood, C.B.E., D.S.O., D.F.C., A.D.C.; Acting Air Commodore A. Pyke, O.B.E., M.I.Mech.E., A.F.R.Ae.S.

Companion (Civil)

W. H. Stephens, Director-General of Ballistic Missiles, M.o.A.

ORDER OF ST. MICHAEL AND ST. GEORGE

Companion

F. Cooper, Assistant Secretary, Air Ministry.

ROYAL VICTORIAN ORDER

Commander

Gp. Capt. A. D. Mitchell, D.F.C., A.F.C., A.D.C.

Members of the Fourth Class

Wg. Cdr. H. G. Currell, D.F.C., A.F.C.; Wg. Cdr. D. Wood, A.F.C.

Vice-Admiral L. G. Durlacher (K.C.B.); Air Chief Marshal Sir Thomas Pike (G.C.B.); Air Marshal S. C. Elworthy (K.C.B.).

G. C. I. Gardiner (C.B.E.); A. W. Bedford (O.B.E.); A. A. Rubbra (C.B.E.).

ORDER OF THE BRITISH EMPIRE

Knight Grand Cross (Military)

Air Chief Marshal the Rt. Hon. P. R. Gardner, Earl of Bandon, K.B.E., C.B., C.V.O., D.S.O.

Knights Commanders (Military)

Air Marshal A. Earle, C.B., C.B.E.; Air Marshal H. P. Fraser, C.B., C.B.E., A.F.C., B.A., F.R.Ae.S.

Commanders (Military)

Acting Air Commodores F. Hume, C. H. Simpson, M.A. Group Captains C. C. Barker, A.F.C., M.B., Ch.B.; A. W. Caswell, O.B.E., A.F.R.Ae.S.; W. D. David, D.F.C., A.F.C.; E. W. T. Hardie; W. D. Hodgkinson, D.F.C., A.F.C., A.D.C.; E. N. Ryder, D.F.C. (Retd.); C. L. Troop (Retd.); F. A. Willan, D.F.C., M.A.

Commanders (Civil)

G. C. I. Gardiner, technical director, de Havilland Aircraft Co., Ltd.; F. E. McGinnety, Director-General of Inspection, M.o.A.; A. A. Rubbra, technical director, Rolls-Royce, Ltd.; C. F. McFarlane, Defence Supply Attaché, H.M. Embassy, Bonn.

Officers (Military)

Wing Commanders the Hon. M. C. Adderley, A.F.C.; G. Buckle; A. S. Cade; E. A. Challis; J. Dalgleish; R. U. P. De Burgh; R. Findlater, D.S.O., D.F.C.; G. A. Fricker (Retd.); L. G. Holmes, D.F.C., A.F.C.; W. T. H. Howell, D.F.C.; D. E. Longley; W. S. O. Randle, M.B.E., A.F.C., D.F.M.; G. H. Tebboth; T. Thomas, D.F.C.; P. D. Thorne, A.F.C. Acting Wing Commanders, A. V. Duffill, D.F.C., R.Aux.A.F.; S. A. Hinde, R.A.F.V.R. Sqn. Ldr. K. Courtnage, A.F.C.

Officers (Civil)

A. W. Bedford, A.F.C., chief test pilot, Hawker Aircraft, Ltd.; R. W. Bevan, Senior Principal Scientific Officer, Air Ministry; D. O. Burt, Engineer I, R.A.E., M.o.A.; Miss M. J. Craig, Secretary, R.A.F. Escaping Society; C. W. McQ. S. Finney, Chief Mechanical Transport Officer, M.o.A.; F. W. J. Gale, M.B.E., managing director, S. G. Brown, Ltd.; D. Grey, Commercial International Manager, B.E.A.C.; Observer Capt. N. F. Lockyer, M.B.E., Commandant, Western Area Headquarters, R.O.C.; H. W. Sanders, Superintending Civil Engineer, Grade I, Air Ministry; F. A. White; Principal, Air Ministry.

QUEEN'S COMMENDATIONS

P. R. Lear, Experimental Officer, R.A.E., Farnborough; S. J. Nicolle, Senior Training Captain, Pionair Aircraft, B.E.A.C.; T. W. Brooke-Smith, chief test pilot, Short Bros. and Harland, Ltd.; J. P. Cunningham, Senior Captain and Flight Captain, E.A.A., East Africa High Commission; Miss J. M. Wright, Commercial Pilot, Wilson Air Service, Ltd., Nairobi.

and third stages, with the second based on French development work. Reports have suggested that the last may involve an improved version of the Véronique sounding rocket with larger tanks and greater thrust. The present Véronique has a thrust of 8,820 lb., which compares with the 16,400 lb. of Black Knight.

The growing potential of France in the development of large rockets is not widely appreciated. A sum of NF.100m. has been set aside, for example, for initial development of the French I.R.B.M., which is believed to be directed towards a two-stage solid-propellent missile capable of projecting a nuclear warhead up to 2,000 miles. The agency responsible for this project is SERAB *(Société d'Etudes et de Realisation des Engines Balistiques)*. Controlled and financed by the French Government, SERAB draws upon the resources of both Government establishments and private industry.

Despite the interest in solid propellents, close attention has also been given to "storable" liquids. The *Société d'Etude de la Propulsion par Reaction* (S.E.P.R.), for example, has done much work with WFNA (white fuming nitric acid) and considers that missiles employing this oxidant could be stored for periods of up to three years.

Considerable experience has been obtained with WFNA in mixed powerplant aircraft. A total of eight different aircraft have been powered by S.E.P.R. rocket engines and more than 4,500 firings have been made in flight. This has involved no fewer than 55,000 ground tests of complete engines, and the consumption of some 2,500 tons of WFNA annually at the height of the programme. Fuels have included furaline (mixture of furfuryl alcohol and xylidine, and TX (triethylanine and xylidine); these are self-igniting (hypergolic) with WFNA.

Non-hypergolic fuels such as JP-4 have also been employed. Research studies have also been made into the use of such liquids as oxygen, fluorine, hydrazine and hydrogen.

The same company has also acquired considerable experience with solid-propellent rocket engines. The surface-to-air missile MATRA R.422, for example, had a S.E.P.R. 732 booster developing a thrust of 50,000 lb. for 4.5 sec., and a S.E.P.R. 705 sustainer producing 3,300 lb. for 20 sec. Some 150 launchings of this combination were made in 1956.

More recently, S.E.P.R. has become involved with ballistic missiles under the direction of *Service Technique Aéronautique*. A research and development programme into lightweight motor cases, case-bonded propellents, swivelling nozzles, and thrust-termination devices is directly related to the I.R.B.M. project.

In the latter work, France is particularly fortunate in having long-established facilities for the manufacture and production of solid propellents at the Government-run *Service de Poudres*. The powder plant at St. Medard, near Bordeaux, is being extensively modernized.

SENSE OF PURPOSE.—A dramatic shot of the latest fighter to go into squadron service with the R.A.F.—the supersonic English Electric Lightning. It is powered by two Rolls-Royce Avons and armed with two de Havilland Firestreak air-to-air missiles.

Photograph copyright "The Aeroplane and Astronautics"

Singapore Air Show

A NINE-DAY international air show is to be held at Paya Lebar Airport, Singapore, in April of this year. To be organized by the Singapore Government, its start will coincide with the opening of a new operations building at the airport by the Head of State on Apr. 8.

More than 250,000 people, including representatives of airlines operating in South East Asia and teams from the Services of neighbouring countries, are expected to visit the show. A large-scale flying display of civil and military types is planned, together with a static aircraft park and an accessory exhibition which will cover a seven-acre site.

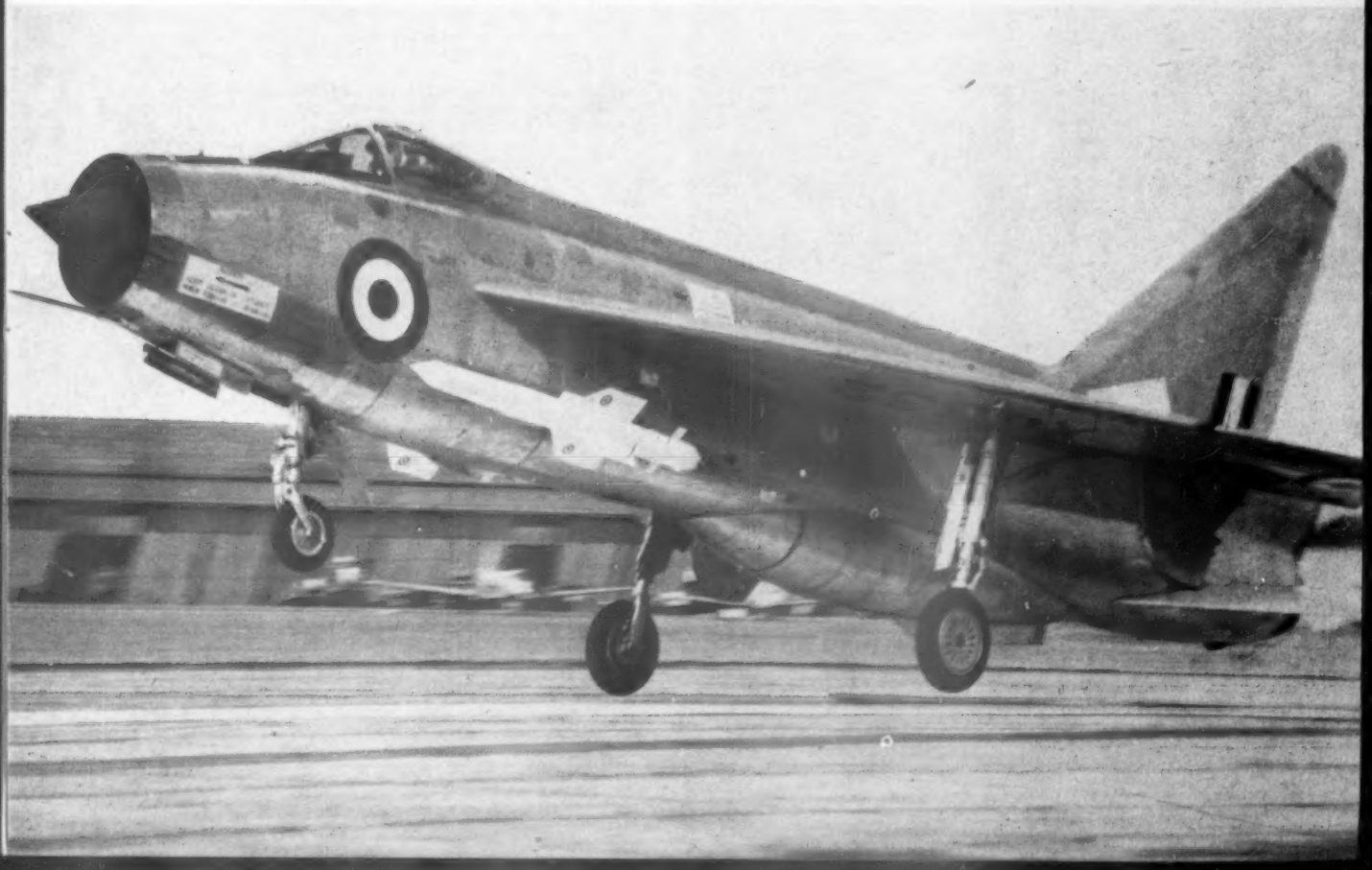
Exhibits will include radio and navigation installations, aircraft spares, electrical and ground servicing equipment. The Japanese stand is planned to consist of mainly electronic components, and Germany will show radar and telecommunications equipment and airfield lighting. Altogether, more than 200 exhibitors, including participants from the British aircraft industry, are expected to participate.

The Singapore Government's official overseas representative for the show is Mr. A. J. Jones, managing director of Masters (1959), Ltd., 16c Cecil Street, Singapore.

Aiding Exports

FROM the official figures that are published from time to time, it is quite clear that the aircraft industry has good cause to be proud of the amount of export business it accomplishes. The overall total for 1960 is not yet available, but it is likely to top the £140 million mark and bring the grand total of aeronautical goods exported since the war to some £1,083 million. Such a record certainly suggests that the industry is not unacquainted with the necessity to export or with the inevitable problems associated with such enterprise.

There may, however, be many companies—particularly in the ancillary industry producing equipment—who are not fully



aware of the facilities and services offered by the Board of Trade to ease the planning of their export drives. These services are centred on the Board's London headquarters and have the invaluable backing not only of its U.K. regional and district offices but of a world-wide complex of commercial officers and trade commissioners. As such, this organization is geared to serve the export interests of the whole of British industry and is available just as much to the small company making an initial attempt to break into the export market as to the large concern seeking to expand its already extensive overseas interests.

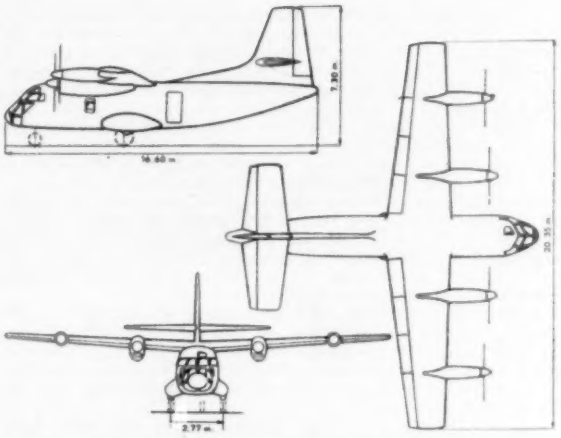
The organization exists, in fact, to supply information on the many queries to which present and potential exporters need answers. How to make full use of this service is explained in an official booklet published by the Export Services Branch of the Board of Trade; it can be obtained free of charge from Lacon House, Theobalds Road, London, W.C.1.

Towards the Slow-Landing Aircraft

BREGUET have announced details of a projected STOL military transport, the Breguet 945. Although very similar in general appearance and concept to the deflected-slipstream Breguet 941, a prototype of which is now being built for the French Air Force, the Breguet 945 is smaller and is powered by two 1,280 b.h.p. Turmo 11D turboshaft engines which drive four propellers. The larger aircraft has four engines of this type.

In the STOL rôle the Breguet 945 will operate at 22,050 lb. all-up weight and will have a take-off distance of 230 yd. to a height of 35 ft. in I.S.A. sea-level conditions. Cruising at 249 m.p.h. it will carry a 3,310 lb. payload—equivalent to a jeep or 15 men—over a range of 930 miles. Its landing distance from 50 ft. is 175 yd. Minimum flying speed is 50 m.p.h.

If STOL performance is not required the aircraft can be operated at 26,460 lb. all-up weight and will carry more than 5,500 lb. over 1,240 miles or more than 8,800 lb. over 310 miles.



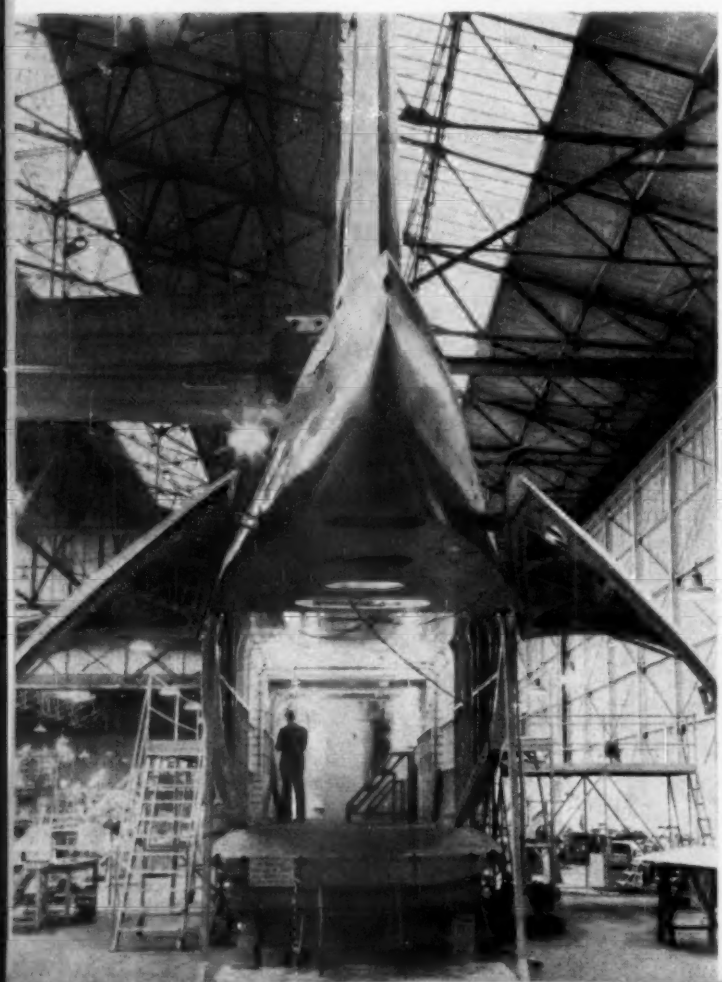
BREGUET 945.—This new Breguet project is a small deflected-slipstream STOL transport for army support duties.

No Compulsory Forms

THE scheme for collecting tourist and migration statistics by means of compulsory questionnaires to be filled in by airline passengers has been shelved—at least for the time being. Instead, a voluntary (and probably verbal) sampling system, covering certain routes and involving four simple questions, will be tried.

The Board of Trade, for which the information is required, has stated that, if the sampling methods are successful, the Government will not make an order for air cards under the Statistics of Trade Act, 1947, "as had previously been contemplated." The information is intended, in particular, for use in estimating tourist receipts and expenditures, which are important items in the U.K. balance of payments.

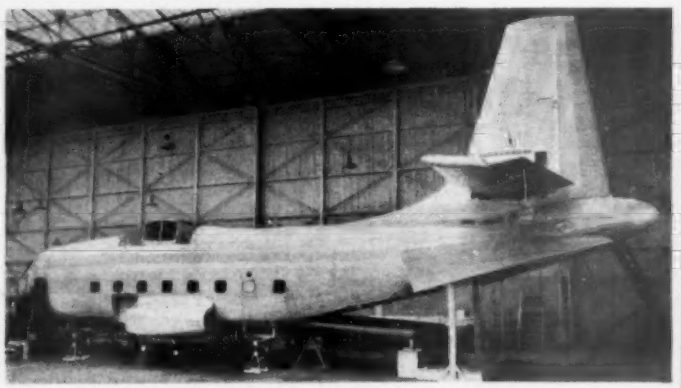
This news represents a minor victory for the airlines and others who resisted the compulsory scheme. Now that the storm in a teacup is over the onlooker is left to wonder why, if the information is so important, the Board of Trade did not itself try harder to find supporters by publicizing the value of the required statistics.



Training Wastage Figures

IN our issue of Dec. 9 last special emphasis was given to the tribute paid by the Commander-in-Chief, Flying Training Command, R.A.F., to the work of the A.B.A.C. We are sorry that our contributor in his enthusiasm should so far have anticipated events by making Sir Hugh Constantine a member of the Air Council.

It has been pointed out that the figures, quoted by the Air Marshal concerning the basic flying stage, did not make it possible to calculate the overall wastage rate from selection to wings standard. The Air Marshal said in his speech that in the Basic Training stage those with air experience had half the wastage rate compared with those with no previous flying experience, and a boy who had had a flying scholarship had only ¼ the wastage also compared with those with no previous flying experience.



SLOW LANDER.—The prototype of the Breguet 941 STOL aircraft is now in an advanced stage of construction. According to reports this is up to schedule and the aircraft is expected to be flying in time for presentation at the Paris Aero Show, in June.

Kerosene—Lord Brabazon Replies to His Critics

SINCE we went to press last week with the correspondence between Lord Brabazon and Sir William Hildred, director-general of IATA, on the subject of the safer fuel for turbine-engined airliners, there has been a further exchange of statement and counterstatement. First was a statement issued by Sir William after the publication of the correspondence. It is reproduced below *in extenso*.

In Canada, Mr. J. T. Dyment, chief engineer of T.C.A., made a statement to the Canadian Press. This, as supplied to us by IATA, is reproduced below in full so far as the technical points are concerned. Mr. Dyment's statement, as one would expect from a forthright airline engineer, does much to answer the question we raised last week, namely, if there are good technical reasons for using JP.4, what are they? It will be seen that in Mr. Dyment's opinion characteristics of JP.4 make it safer than kerosene under certain airborne conditions.

We print Lord Brabazon's statement last.

The technical argument seems, therefore, to be establishing itself around the relative advantages of improving the safety factor in the air compared with doing so on the ground. It is essential on these occasions where strong emotional feelings are aroused to lose neither sight of the goal nor a sense of proportion.

It is still horrifying to recall how many British pilots lost their lives in the First World War because parachutes could not be approved until they were 100% reliable. Even if parachutes had only worked 10 times out of 100, lives of many good fighting men would have been saved.

The point that Lord Brabazon is working so hard to get accepted is that none of us in the aviation business can afford to neglect any action that will reduce the toll in accidents which are bound to occur. His arguments are designed to show that where kerosene is used passengers have a better chance of getting out of the aircraft in certain kinds of accidents. It may well be that some such organization as the Flight Safety Foundation could supply figures to show with what sort of frequency such accidents occur.

When a Boeing 707 of B.O.A.C. ran off the runway at London Airport on Christmas Eve, it did not catch fire though a fuel tank was punctured. However, the air correspondent who deduced from this that B.O.A.C. had made a recent decision solely to use kerosene did the Corporation an injustice. In principle they have never used any other fuel for their jets since the introduction of the Comet in 1953. We say, in principle, since in exceptional cases where kerosene was not available other fuels were, on occasion, used.

Not one of us in aeronautics can afford to be complacent about accidents and since the amount of commercial flying continues to increase, the number of fatalities will increase with it, even if the accident rate remains the same. Figures compiled in this office from reliable sources indicate that at least 1,360 people were killed during 1960 in, or as a result of, accidents to commercial transport aircraft. Next year's figures must be worse unless the safety factor can be improved.

There is thus every reason for resolving at the start of 1961 to let no opportunity pass of so developing our transport aircraft that not only will they land slowly but also they will *not burn up*.

SIR WILLIAM P. HILDRED, director-general of IATA, said:—

"In view of Press statements attributed to Lord Brabazon, it should be pointed out that JP.4 turbine fuel is neither new nor highly explosive.

"JP.4 has been extensively proved by years of use in both civil and military aircraft. It is accommodated in specifications of engine manufacturers. Its use has been sanctioned after full consideration by the safety authorities of governments, including the Air Registration Board of the United Kingdom, of which Lord Brabazon is chairman.

"JP.4 is less volatile and less explosive than fuels which for years have been used in piston-engined aircraft—and for that matter is less volatile than the gasoline which an automobile owner puts into his own tank.

"The choice of a fuel is a matter for highly involved technical analysis by an individual airline. The characteristics of JP.4 and kerosene vary widely, often depending on the source of the basic petroleum from which both derive. Under a given set of conditions, JP.4 may be more susceptible to ignition; while under other conditions the reverse may be true. An airline selects one fuel or the other—and in some cases elects to use both—on the basis of its own assessment of the frequency with which it will meet these various conditions in its own pattern of operations. Price does not become a factor until an airline is fully satisfied on the point of safety. Indeed, the relative prices of JP.4 and kerosene vary in themselves: for example, kerosene, which is not taxed as aviation fuel, is cheaper in the United Kingdom.

"The techniques and equipment for handling JP.4 and kerosene on the ground and in the air have been perfected after many years of experience with gasoline. Whichever fuel is used, an airline's basic interest is in the safety of its passengers and aircraft. Neither is expendable."

MR. J. T. DYMENT'S statement:—

"As airline operators we can't take one safety factor alone—we have to study the whole thing.

"We have to look at all aspects of it—reliability of operations and the various types of accidents that can occur.

"In the type of accident that results in fuel being spilt on the ground, JP.4 is more likely to ignite if there is a spark above it than kerosene and this is all that Lord Brabazon is talking about. Unfortunately, it is far from the whole picture.

"If there is a severe impact—say, if the wing strikes the ground and the fuel tanks break open—there is no difference between kerosene and JP.4. You just can't tell them apart if the fuel splashes.

"In addition, the research agencies of the U.S. Government investigated the common causes of fire in aircraft accidents and found that, contrary to popular belief, sparks are not a common cause, because the electrical system goes out in the crash. They found the most common cause of fire after an accident is from engine oil or hydraulic fluid coming in contact with hot metal. This is what causes most fires.

"As for hydraulic fluid, TCA was the first airline in the World to test in operations fire-resistant hydraulic fluid and it is widely used now.

"Kerosene is closer to engine oil than gasoline and they found that it will ignite from contact with hot metal parts as much as 400° lower in temperature than JP.4.

"If you get a leak in a fuel tank in a wing, kerosene will crawl and JP.4 will evaporate. The danger of kerosene coming in contact with a hot part as it did in a Vulcan is greater than with JP.4.

"Engine reliability is synonymous with safety and if you have a flame-out in the air—and you can still get them from icing—you are far, far more likely to get them restarted with JP.4 than with kerosene. There is just no comparison.

"Kerosene burns at a hotter temperature than JP.4 so the engine parts are hotter and this affects reliability.

"Because of their higher fuel consumption, the tolerances in turbine engines have to be much closer than with piston engines and dirt has a more serious effect. Anything close to oil, as kerosene is, needs a longer time for the dirt to settle out—dirt stays in suspension longer in kerosene than in JP.4.

"In the case of engine fire, with flames coming back over the wing, the vapour from JP.4 will cool the skin of the aircraft faster than kerosene and kerosene becomes explosive for a much longer time. JP.4 will produce an explosive mixture only through a very narrow range of air-fuel mixtures because it quickly becomes too rich to explode.

"There is another factor that we don't know very much about yet—static electricity. Kerosene does pick up static more readily. To what extent a hazard is involved is not known. JP.4 should be better.

"If everything in the engine is exactly right, both burn equally well. But the whole reliability of the engine is jeopardized more with kerosene because of a tendency it has to build up carbon deposits and consequently hot spots.

"Smoke generation is greater with kerosene than JP.4 and where you have smog, as at Los Angeles, this is serious. Jet operations have completely blanked out Los Angeles and forced them to suspend flying.

"In spite of what I have said we don't think there is any reason why an airline shouldn't use any of the standard fuels. You must look at your own operating conditions and decide which is preferable.

"When we selected JP.4 we were told it would cost more than kerosene and we still picked it. As it has turned out, you can toss a coin between them so far as cost is concerned. It depends where you are.

"And in spite of what Lord Brabazon says, safety has always been the No. 1 consideration with all airlines—it has to be."

LORD BRABAZON'S reply:—

"My friend Sir William Hildred gives us a lot of facts that are well known, and with which I do not actively quarrel, but he is so near the trees he does not see the wood.

"The facts are these. In the past aeroplanes were compelled to use petrol, as it was essential for piston engines.

"We have always been aware that it was of all fuels the most dangerous to carry, but we had to put up with it, and machines carrying it were, and are today, deemed airworthy, if not entirely crashworthy. A turbine-engined aeroplane stands in the same position as a piston engine, but the point is it can and does operate as successfully on kerosene, thereby reducing the possibility of instantaneous fire in the case of a minor accident when fuel is spilt from broken tanks. The risk is small but the hazard exists.

"I cannot, of course, predict what a court of law would say on investigating an accident in which JP.4 was used and loss of life through burning resulted.

"Whether using a fuel more dangerous in the event of a minor crash than necessary would be construed as negligence would be for the court to decide, but I cannot help reminding operators that were such the case, claims would be unlimited and a charge of manslaughter would have to be faced.

"Sir William accuses me of frightening the travelling public: I sincerely hope I have frightened air operators into coming down to earth safely."

Aviation News in General

PERUVIAN T-37s.—The Peruvian Air Force is to be equipped with Cessna T-37 primary jet trainers and the first aircraft are expected to be delivered next month. At present operating Hunters, Sabres and Canberras, the P.A.F. will be the first South American air force to introduce all-through jet training.

MORE MAGISTERS.—A new order for 70 Potez-Air Fouga CM.170 Magisters for the French Air Force brings the total to 711, of which 310 are for the French services and 401 for five foreign countries. Of the foreign orders, 261 are for construction in Germany, Israel and Finland. After the Alouette, the Magister is the most successful French post-War aircraft in terms of numbers sold.

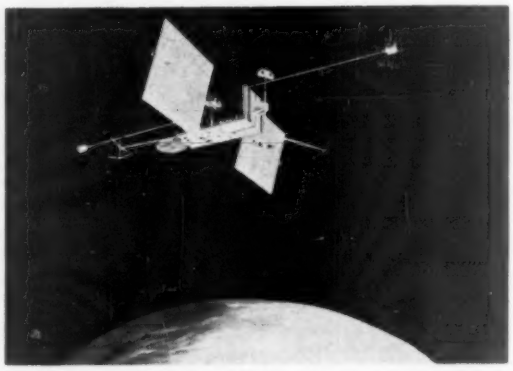
HAWKER SIDDELEY NEWS.—The former de Havilland Aircraft Company of South Africa has become Hawker de Havilland (Pty.) Ltd., with headquarters in Johannesburg. Mr. Jack Davison, O.B.E., F.C.I.S., has been appointed managing director. He joined the D.H. Co. in South Africa on its formation in 1930 and became its managing director in 1945. The new company will be responsible for handling all Hawker Siddeley and de Havilland aviation and industrial interests in South Africa.

500 ALOUETTES.—On Dec. 19, Sud-Aviation announced delivery of the 500th Alouette II turbine helicopter. Another 227 are on order. Of the total, 350 are for the French Army, Navy and Air Force, and 377 for French civil customers and for export.

MATS BUYS HERCULES.—A contract for 16 C-130E Hercules transports has been placed with Lockheed, for delivery to MATS starting in March, 1962. The C-130E, MATS orders for which are expected to total 50 over two years, is a long-range version of the C-130B and is the first type ordered for the MATS interim modernization programme.

ONE SOLUTION TO NOISE.—Following protests about jet noise from the occupants of 78 houses near Copenhagen Airport, Kastrup, the Danish Government has arranged to purchase the houses and demolish them.

UNITED INTEREST.—The United Aircraft Corporation has acquired a 15% interest in Ratier-Figeac, a French company with headquarters in Paris and manufacturing facilities in south-west France. Ratier-Figeac has been a licensee for Hamilton Standard products for six years.



SPACE LAB.—Latest configuration of NASA's first standardized research satellite, the "Orbiting Geophysical Observatory." Vehicle will be about 6 ft. long and 3 ft. square and equipped with two large solar-cell vanes. First launching is expected in 1963.

LASA-60 IN MEXICO.—A new prototype of the Lockheed LASA-60 utility transport, powered by a 260 h.p. turbo-supercharged Continental engine, has been delivered from the Marietta factory to San Luis Potosi in Mexico. The first production LASA-60 from the Lockheed-Azcarate factory in Mexico is expected to be completed in February.

TURBOFAN DC-8.—The prototype Douglas DC-8 Series 50 with JT3D-1 turbofan engines made its first flight at Long Beach on Dec. 20. Production aircraft will join the flight trials before the end of January. Orders for the Series 50 include five for K.L.M., three for Iberia, two for Aeronaves (Mexico) and three for United.

CARIBOU ORDER.—The U.S. Army has ordered a further 24 Caribou transports from de Havilland, Canada. The U.S. Army now has 51 Caribou on order; the first 27 are now in production and the new batch of 24 will come off the Toronto line at four per month during 1962.

MARTIN PLANS.—The last Martin aeroplane—a Marlin flying-boat—was delivered recently to the U.S. Navy. The company has now ceased aircraft production and will devote its energies to missiles, electronics and astronautics.

CO-OPERATION?—It is believed that the U.K. and other European countries will contribute to the NASA programme for developing very light-weight active communication satellites. These are expected to be placed in Polar orbit at 3,000 to 5,600 miles within 18 months.

SPACE LAW.—A report written for the American Bar Foundation states that space is a vast resource which can be shared and to which no nation has exclusive rights. Eventually space law will have to define which space activities should be discouraged or prohibited but a detailed code or convention might be premature or even harmful today.

SOVIET SHIP ROCKET.—A meteorological rocket was launched from the Soviet research ship Y.M. Shokalsky in the Pacific, "the first to be sent up by Soviet scientists in the tropical atmospheric belt," according to Tass.

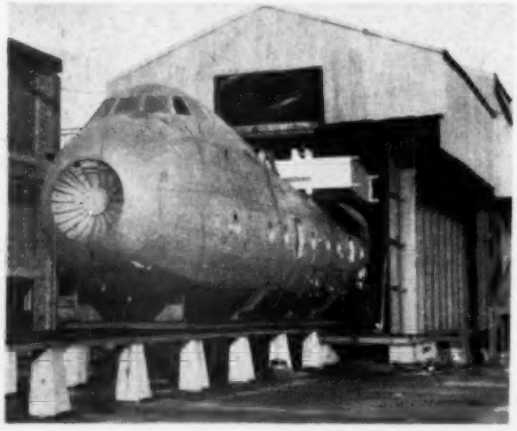
U.S. SPACE URGE.—Mr. Lyndon Johnson, U.S. Vice-President elect, has confirmed that the incoming Kennedy Administration is planning a vigorous and accelerated space exploration programme.

SEGMENTED ROCKET.—NASA announced on Dec. 26 the successful firing of a "high-energy" solid-propellent rocket made on the "building block" principle. Test was made by the United Technology Corpn. of Sunnyvale, Calif. Motor was manufactured in three pieces, each weighing about half a ton. Flight-weight test motor is 7 ft. long and 3.5 ft. in diameter; static thrust exceeds 15,000 lb.

AFRICAN TRACKER.—Work has begun on the site of the 85-ft.-dia. steerable radio-telescope to be established near Krugersdorp, South Africa, as a result of an agreement between NASA and South Africa's Council for Scientific and Industrial Research. Third of its kind to be established by NASA, it will be used for space-probe tracking in conjunction with stations in Goldstone, Calif., and Woomera, Australia.

SILENT SATELLITE.—Explorer VIII, the satellite launched on Nov. 3 to measure the ionosphere, has ceased transmissions because of a battery failure. Its effective lifetime was expected to be between two and three months.

NOT SO SMALL.—In our account of the Handley Page annual senior staff party in London on Dec. 19 (THE AEROPLANE AND ASTRONAUTICS, Dec. 30) our report inadvertantly decimated the company's strength. Our figure of 35 members and guests present should, of course, have been 350.



LONG LIFE.—This Argosy fuselage has successfully completed two years of continuous testing in the water tank at Coventry. Other structural fatigue tests with a complete Argosy airframe are continuing; and an AW660 (military) fuselage is about to be installed in the water tank.

Commercial Aviation Affairs

MERGER APPROVED.—The C.A.B. examiner in the Capital Airlines-United Air Lines merger case has recommended that the merger be allowed. The full board has still to consider the proposal, which will be dropped if C.A.B. approval is not forthcoming by mid-February.

EUROPEAN TRAFFIC.—Passenger miles flown by the 11 member airlines of the Air Research Bureau in November increased by 25% over the November 1959 total, but the average passenger load factor fell from 48.8% to 48.2%. In the twelve-month period ending October 1960, passenger miles completed were up by 20% and the passenger load factor improved from 57.2% to 57.6%.

AIRLINES OF NEW ZEALAND.—This is the name proposed for a new domestic airline which hopes to start low-cost services through provincial centres in New Zealand with DC-3s. Ansett Transport Industries holds a substantial minority interest, and R. M. Ansett and R. R. Walker have joined the board to represent the Australian company. The chairman is Charles Edwards, operator of ground transport and tourist services in New Zealand and a shareholder in Bay of Plenty Airways.

TAROM TO LONDON?—The Rumanian State airline Tarom is reported to be planning a thrice-weekly service to London starting next spring with Il-14s and, later, Il-18s. The service will be via Paris.

F-27 NEWS.—Philippine Air Lines has ordered a third F-27 from Fokker, bringing the total sold by the Dutch company to 86 (83 have been sold by Fairchild). The first F-27 for the New Zealand National Airways Corp. arrived in Wellington on Dec. 12.

ARCTIC SERVICE.—A new scheduled service has been opened by Aeroflot between Moscow and Magadan, an Okhotsk Sea port in eastern U.S.S.R. Operated by Il-18s, it goes by way of Archangel'sk and then Nar'yan Mar, Amderna and Tiksi, airfields along the North Arctic coast which have previously been served only by feeder-lines and aircraft of the Polar Aviation Directorate.

MORE CARAVELLES.—Finnair has ordered a fourth Caravelle and, according to reports, Alitalia is ordering two Caravelle VIs, giving this operator, with its eight Caravelle IIIs on order or in service, a total fleet of 10. Finnair has a fifth Caravelle on option. Total firm airline orders for the Caravelle are now 103.

SWISSAIR JETS.—Addition of four more Caravelles to the Swissair fleet has been authorized by the board of directors, and negotiations have been initiated. It is not yet announced whether these will be leased (as are the four Caravelles used at present) from S.A.S., or purchased outright.

P.A.A. TO AFRICA.—Boeing 707s replaced DC-7Cs on the Pan American services between New York and Johannesburg on Jan. 9. One weekly service is via Dakar, Monrovia, Accra and Leopoldville, the other via the Azores, Lisbon, Dakar and Monrovia to Accra only.

707 CRASH AT L.A.P.—On Dec. 24 a B.O.A.C. 707-436, carrying 95 passengers with 11 crew members, slewed off London Airport's runway 23L (7,734 ft.) after landing and was severely damaged. There were no casualties. The 707 had flown from Chicago via Detroit, Montreal and Prestwick.

T.W.A. TRUSTEES.—The board of trustees to administer Howard Hughes' 78% holding in T.W.A. (see our previous issue) will comprise Mr. Ernest R. Breech, former chairman of Ford Motor Company, and Mr. Irving S. Olds, former chairman of U.S. Steel, together with Mr. Raymond M. Holliday, representing Hughes Tool.

NON-STOP TO L.A.—Pan American completed what is believed to be the first non-stop commercial flight between London and Los Angeles on Jan. 1. Flight PA121 (Capt. Eugene Myring) left London at 16.19 hrs. G.M.T. on Dec. 31, and reached Los Angeles (5,140 naut. miles) in 11 hr. 42 min., carrying 37 passengers, 13 crew and 8,500 lb. of freight. It left London Airport at max. weight with full tanks (155,000 lb. fuel) and had 13,000 lb. of fuel unburnt on arrival. There was nil wind component, the average speed being 436 knots.

L.A.P. CLOSED.—For 45 minutes on Dec. 29, none of London Airport's five runways was available for use by large jet aircraft. No. 1 was closed for temporary repairs to the surface; No. 2 still had the damaged B.O.A.C. Boeing 707 at the south end, reducing its effective length to 6,000 ft.; and Nos. 6 and 7 are restricted in length where they intersect No. 5, which is out of use until March while it is being lengthened.

QUEBECAIR ELANDS.—Using the Canadair 540 demonstrator on lease, Quebecair operated a scheduled 1,600-mile round trip from Montreal to Knob Lake via Quebec City, Rimouski, Seven Islands and Wabush five days a week for three months with only two cancellations (one due to weather). In the first 64 days from Aug. 24, a total of 435 hr. was flown, 398 of them on passenger service. Two Canadair 540s have now been purchased by Quebecair.

CANADIAN TURBOPROP.—Quebecair, which recently took delivery of two Eland-engined Canadair 540s, also leased a 540 demonstrator during 1960. It is seen here loading freight at Seven Islands Airport.

News About People

U.S.A.F. SECRETARY.—The United States President-elect, Mr. Kennedy, has appointed Mr. E. Zuckert to be Secretary of the Air Force. A Washington lawyer, he was assistant Secretary of the Air Force between 1947-52.

B.O.A.C. IN ITALY.—Mr. R. W. Cole has been appointed senior B.O.A.C. representative in Italy with effect from Dec. 1. He took over from Mr. W. V. Sherwood, whose new appointment is in New Delhi.

E.A.A.C. APPOINTMENTS.—East African Airways has set up a commercial department, and Captain P. A. Travers, sales manager since 1954, has been appointed to the new position of commercial manager. He is succeeded by Mr. J. W. Baines, who is in turn replaced as sales promotion manager by Mr. J. Hayes. Mr. P. T. Jolley has been appointed to the new post of sales development manager responsible for advertising, publicity, public relations and inter-airlines sales co-operation.

SOUTH AMERICAN NEWS.—Mr. M. A. Snowball has assumed managerial control of the whole of B.O.A.C.'s effort in the South American continent, with Mr. G. W. W. Dodd assuming responsibility for sales in the same area. Mr. Snowball was previously assistant general manager (South America).

CHANGE OF CHAIRMAN.—Mr. N. A. Morling has succeeded Mr. G. S. Sutcliffe as chairman of Ferodo, Ltd. Mr. Sutcliffe has resigned his directorship of Ferodo, Ltd., and assumed the chairmanship of three other companies of the Turner and Newall Organization—held by Mr. Morling for the past four years.

ITALIAN D.G.C.A.—With effect from Jan. 1, Generale di Divisione Aerea Felice Santini has taken over the post of Director General of Civil Aviation in Italy. General Santini relieves General Abbriata, who is to become Commander of the Italian D.A.T., the equivalent of Fighter Command.

Air Transport

Testing the Act

BRITISH UNITED AIRWAYS applied last week for a network of scheduled air services, most of which would compete directly or indirectly with the services of B.E.A. and B.O.A.C. The application is now before the Air Transport Licensing Board and will require the first major decision by this board, set up under the terms of the Civil Aviation (Licensing) Act, 1960. If the board's decision is to be in keeping with the spirit of the 1960 Act, which allows controlled competition between the State Corporations and the independent operators, some penetrating analyses of traffic flows and potential is going to be required in this case, which will thus test the A.T.L.B. Secretariat as well as the board itself.

All the services proposed by B.U.A. would be operated from Gatwick, and fall into three categories as follows:

(a) Long haul scheduled services to Lagos, Johannesburg and Khartoum to augment the existing network of "Safari" routes to East, West and Central Africa: initially at weekly frequencies with Britannias, later to be replaced on all the African routes by new long-range jets.

(b) A pattern of scheduled services to Paris, Brussels, Amsterdam, Frankfurt, Zurich, Dusseldorf, Cologne, Munich, Turin, Milan, Rome, Genoa, Manchester, Glasgow, Edinburgh, Belfast and Dublin. Frequencies applied for on these routes range from twice-weekly to twice-daily.

(c) Seasonal scheduled services to European and other resorts, designed for holidaymakers: Madeira, Palma, Barcelona, Nice, Lourdes, Naples, Palermo, Basle, Athens, Biarritz, Cairo/Luxor, Venice and Nicosia. Frequencies applied for on these routes range from once-fortnightly to five times weekly.

It is proposed initially to operate all services in the latter two categories with Viscount aircraft, with the option to introduce new jets at a later date.

The Pattern of the New York Collision

FROM the A.T.C. tape recordings, which were released by the F.A.A. on Dec. 21, and from other preliminary reports, the broad pattern of events which led to the New York collision disaster can be pieced together. The basic facts were reported in our Dec. 23 issue, p. 819.

The T.W.A. L-1049 had entered, but was not instructed to hold in, the pattern over the Linden, N.J., intersection (south-west of Newark). It had been cleared down to 1,500 ft. for an ILS approach to La Guardia and was making a radar-vectored descent. The United DC-8 had been cleared for a descent from 14,000 ft. over Allentown, Pa., to 5,000 ft. in the holding pattern over the Preston, N.J., intersection (south of Staten Island).

Idlewild's Traffic Control Centre had asked the DC-8, while it was on the way down from 14,000 ft., whether it would be able to descend to 5,000 ft. before entering the Preston stack. The DC-8 had replied: "Will head it right on down; we'll dump it." At 15.33½ hrs. G.M.T. it called Idlewild Approach Control to report that it was approaching Preston at 5,000 ft. Idlewild had replied with weather information and with instructions to hold at 5,000 ft., but the DC-8 had not acknowledged. This was just before 15.34 hrs. G.M.T.

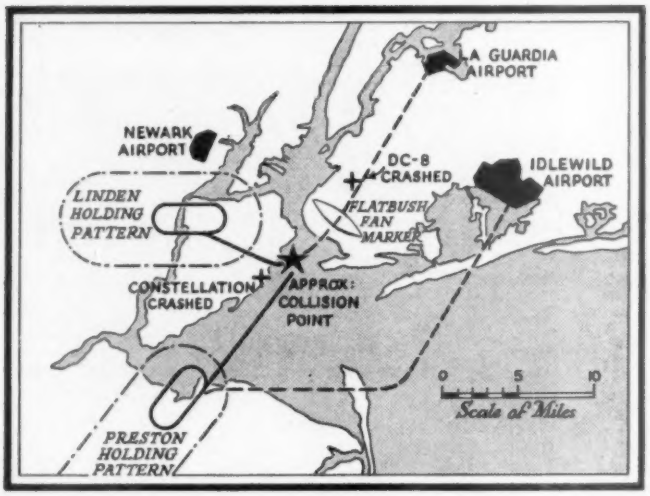
Meanwhile the L-1049 had been warned by La Guardia A.C. that there was jet traffic on its right, "now three o'clock, at one mile, north-east bound." This was the DC-8. There was no reply from the L-1049—only the sound of an open microphone for about six seconds.

Reports say that examination of the wreckage of the DC-8 showed that it was banking sharply (50°) to the right at the moment of impact—which suggests that one of its pilots may have seen the L-1049. The starboard outer engine of the DC-8 struck the cabin of the L-1049 aft of the trailing edge and this powerplant, with part of the jet's right wing and aileron, were found with the wreckage of the L-1049 on Staten Island. The crippled DC-8 continued (as seen on the radar displays) in a north-easterly direction until it crashed in Brooklyn, between the Flatbush fan marker and the outer marker for the approach to La Guardia.

The following excerpts from the recorded conversations between controllers cover some of the period immediately after the collision:

La Guardia A.C. to La Guardia Tower: "I think we have trouble with a Connie. There's something wrong. He's not moving or anything. He might have got hit by another airplane. . . ."

La Guardia Approach Control to Idlewild Control Centre: ". . . we lost contact with T.W.A. two six six . . . he was on a collision course with an aircraft, an unknown aircraft. . . . That aircraft is now a mile outside the La Guardia outer marker, heading north-east bound. . . ."



La Guardia A.C. to Idlewild Approach Control: "Is that your traffic at Flatbush?"

Idlewild: ". . . It could be ours on approach control, New York."

La Guardia: ". . . what type of aircraft is that?"

Idlewild: "A United DC-8."

La Guardia: "And what's his altitude?"

Idlewild: "He was last cleared to 5,000 ft."

La Guardia: "Oh boy, our man was at five, too."

Later reports say that one of the VORs providing a fix in the Preston area had been the subject of pilots' complaints during the day. One of the DC-8's two VOR receivers was inoperative. At the time La Guardia's PAR and the glide-path of the ILS were inoperative.

The flight recorder recovered from the wreckage of the DC-8 had a badly damaged case and the last 15 min. of the metal tape was gummed with burned insulation material. Later reports suggest that the record—which provided information about heading, time, altitude, speed and *g* forces—has been cleared and is available for the investigation. If so, it will provide evidence which, as we pointed out in last week's issue, would otherwise have been unobtainable in an accident of this kind.

Shocking Statistics

THOSE who are engaged professionally in the airline and aircraft business have a tendency to regard accidents as statistically inevitable and all part of the business. This is perhaps necessary for one's peace of mind; but, however fatalistic the attitude, few can fail to be shocked by 1960's grim total of at least 1,360 persons killed in, or as a result of, accidents to commercial transport aircraft.

This total—based on Lloyd's reports—takes account of all known accidents to civil-registered transport aircraft, whether on scheduled, charter or training flights. It includes at least 1,070 passengers, 15 persons killed on the ground and 43 killed in lightplanes or military aircraft which were in collision with airliners. The number of passengers killed in accidents to aircraft on scheduled services (excluding the U.S.S.R. and China) was at least 878, compared with 625 (ICAO statistics) in 1959. This indicates, provisionally, a fatality rate of at least 1.27 per 100 million passenger-miles—the worst since 1954, when it was 1.38.

The number of scheduled airline accidents involving passenger fatalities in 1960 was 38, including one on the ground and counting a mid-air collision as one accident. On this basis, there were 0.43 accidents per 100,000 aircraft hours flown, also the worst figure since 1954.

While the amount of air traffic continues to increase—ICAO has announced a 14% increase in passenger-miles for 1960—an annual increase in the number of persons killed is inevitable unless the standards of air safety are improved. What is particularly disturbing about the 1960 statistics is that not only have the standards worsened, but that there is no single, easily identified cause for this situation. Least of all can the introduction of the big jets be blamed, since the only fatal accident to a jet was that of the DC-8 in the New York collision.

We hope to analyse the year's accidents in detail in our next issue, which will include a tabulation of all the accidents on which the above-quoted statistics are based.

Air Transport . . . .

The Busiest Airports

A RECENT exchange of correspondence in *The Times* about collision risks over the U.K. led us to do a little research into the matter of relative congestion in the air.

In the course of a letter published on Dec. 19, stressing the need for a unified A.T.C., the Master of the Guild of Air Pilots and Air Navigators (Dr. Kenneth G. Bergin) had written of "the crowded airspace over this island, which is virtually a Piccadilly Circus of the air." In *The Times* of Dec. 24 the chairman of the British Gliding Association (Mr. Philip Wills) offered figures and facts to show that the British skies are very far from being crowded and to make the point that the professionals must not be allowed to "keep our air to themselves." He wrote that, in terms of aircraft movements handled annually, L.A.P. is 41st in the list of World airports.

According to available figures for the year 1959, London Airport was, in fact, 82nd in the list of European and U.S. (and probably World) airports and, with 129,641 total aircraft movements, follows Charlotte, North Carolina, which handled 130,199 aircraft. By contrast, Chicago's Midway, the busiest airport in the World, dealt with 431,600 operational movements—or nearly 50 aircraft every hour through the 365 days of the year.

Of course, the movement figures for a high proportion of the 81 busier-than-L.A.P. airports in the U.S.A. are largely made up of private and executive aircraft—and this was the point that Mr. Wills was making. If air-carrier movements only are included, L.A.P., with 118,809, comes 12th in the list, following Cleveland, Ohio, which handled 119,727 such take-offs and landings. On this basis Midway is still top (with 345,170 movements) followed by Washington, Los Angeles and New York's Idlewild and La Guardia in that order.

As for crowded skies in terminal areas, New York's four airports (including Teterboro, the private and executive centre) handled a total of 926,334 movements against the London area's 273,539 (including Southend). In other words, there were 106 aircraft arriving at, or departing from, New York every hour against London's 31 per hour. Chicago's two airports, Midway and O'Hare, handled a total of 666,583, or 76 per hour.

It seems that the U.K. has a long way to go yet before its air reaches a point of dangerous saturation, even in main terminal areas. Perhaps its major airports have not yet become busy enough to begin to pay their way.

How Much Competition?

A LONG, close look at the extent of competition desirable between U.S. international airlines is taken in a special report prepared for the President by United Research Inc.* Made in accordance with a study contract concluded last May, the report was submitted to the White House in November. Although its conclusions are concerned only with U.S. carriers, they are significant to all airlines flying in competition with these carriers; and much of the research and analysis on which the conclusions are based could be used to plot the future pattern of operations by other airlines.

The report deals with the amount of competition which should be allowed (by the Civil Aeronautics Board and, ultimately, the President) between U.S. flag air-carriers operating abroad. In order to reach valid conclusions, an attempt is made to lay down the minimum standards which permit "multiple designation" (i.e., certification of two or more carriers) on a single route. This is done from a consideration of airline costs, break-even load factors and required trip frequency.

An analysis of the costs of U.S. international carriers in the year ended Jne. 30, 1960 (including aircraft operating costs—see table), shows that the size of the carrier is not necessarily significant, but that a reasonable density of operations and traffic is required to cover the fixed and station costs. The advent of jet aircraft has tended to raise what must be regarded as a reasonable minimum level of traffic.

Break-even load factors on U.S. international services have recently been running at an average of 58%-62% but are expected to become somewhat lower with the anticipated lower operating costs of jet aircraft. The report argues that a service frequency of at least one round trip a day is desirable on international routes. Multiple designation, which leads two carriers to reduce frequency or to resort to multi-stop services in order to maintain break-even load factors, is thus not desirable. By 1965, it is suggested, the average express international aircraft will have about 130 seats (mostly tourist and economy) and will have a break-even load factor of not more than 62%. On any particular route between the U.S. and an overseas destination, an average of 80 passengers a day in each direction, or 58,000 a year in all, would be required to justify one round trip a day. Twice this number, 116,000 a year, is suggested, therefore, as the minimum for multiple designation of routes. It is assumed that U.S. carriers will attract the following proportions of total traffic in 1965: Atlantic, 40%; North and Central Pacific, 60%; South Pacific, 35%; and South America 50%.

This suggested traffic level is, of course, only the broadest of yardsticks. Many other factors must be considered including international political relations with their bearing on traffic rights; national defence requirements; the development of pools and consortia by the foreign airlines competing with the U.S. carriers; extension of non-stop services between distant points; and so on. The report does apply its suggested standards, however, to the Atlantic, Pacific and South American areas, and reaches the following specific conclusions:—

ATLANTIC AREA

1. No additional points in Europe or the Middle East warrant multiple designation of U.S. carriers, either now or in the near future.
2. If an overall programme of adjustments of route patterns in Europe is undertaken, Pan American should be de-certificated at Lisbon.
3. Competitive service by two U.S. carriers is not warranted at Madrid.
4. Frankfurt may become unsuitable for two-carrier service if it develops into a primary European gateway, in which case suspension of T.W.A. should be considered.
5. No second U.S. round-the-World service in competition with Pan American's is warranted.
6. The Seaboard and Western all-cargo service does not appear to harm the other U.S. carriers, but should not be subsidized or expanded to handle additional types of traffic.

PACIFIC AREA

1. Competitive service from the U.S. east coast to the Far East via Alaska is not warranted (this is contrary to the recommendation of the C.A.B. examiner in the recent Trans-Pacific Route Case).
2. Pan American should not be allowed east coast co-terminals for routes to the Far East across the central Pacific.
3. Northwest should not be allowed Californian gateways for central Pacific traffic, nor a central Pacific route. If a central Pacific route *is* awarded to Northwest—for other than economic reasons—the Portland/Seattle route to Hawaii should be extended to Tokyo.
4. Extension of the T.W.A. route from Bangkok to Hong Kong and Tokyo does not appear justified, but if a second round-the-World service is wanted—for other than economic reasons—T.W.A. and Northwest should meet at Hong Kong.
5. Certification of an all-cargo service in the Pacific appears to be unwarranted.

SOUTH AMERICAN AREA

1. Point-to-point competition in this area is already excessive.
2. The most desirable pattern of U.S. carrier service would be a single east coast airline and a single independent west coast airline, competing only at Buenos Aires. Such a pattern could be achieved by resolution of the Panagra control question (the U.S. government at present has an anti-trust suit against Pan American, Panagra and W. R. Grace and Co.); a merger of Panagra and Braniff routes and suspension of Braniff service at Rio de Janeiro and Sao Paulo.

INTERNATIONAL OPERATIONS, JULY 1959 – JUNE 1960

Airline	Operating costs, cents/available ton-mile					
	DC-8	707-121	707-331	DC-7B	DC-7C	DC-6B
Braniff	—	—	14.91	17.89	—	—
Delta	—	—	—	18.15	—	—
Northwest	—	—	—	—	16.79	16.73
Panagra	18.94	—	—	25.37	—	18.15
Pan American:						
Atlantic	20.80	17.97	14.39	—	26.30	27.63
Pacific	—	—	13.14	—	23.70	29.90
Latin America	20.10	16.84	14.51	24.38	26.03	18.91

* "Competition Among United States International Air Carriers," prepared by United Research Incorporated, 808 Memorial Drive, Cambridge 39, Massachusetts, U.S.A. In addition to the United Research staff, the report is attributable to Prof. W. Cherington, who supervised the research and analysis with Dr. William Hamburger, and to Prof. George P. Baker, also of the Harvard School of Business Administration, who served as senior consultant.

Airliner Markets of the 'Sixties

M. J. HARDY *discusses some factors influencing this country's share of future markets, the demand for cheap air travel and the significance of pooling.*

A YEAR has now passed since the process of regrouping the British aircraft industry was initiated, and the Ministry of Aviation was formed to provide that focus of authority the lack of which had been for so long recognized as a major weakness in this country's aviation policy-making. In America, Boeing, Douglas, Convair, Fairchild and Lockheed have all shown losses—in some cases heavy—on their commercial aircraft now in production, and current orders for the 707, DC-8, Fairchild F-27 and Electra have been at least two-thirds fulfilled. In this country, the last Britannia has recently been delivered to an airline, and only some nine Viscounts and 12 Comets remain to be delivered to other airlines. Of the current generation of jet transports, only Boeing 720 and Convair 880/600 deliveries are substantially less than half the existing orders, while Caravelle deliveries have just topped the half-way mark. With few sizeable new orders in prospect, now that Eastern and United have chosen the 727, and several important jet and turboprop production programmes nearing completion, it seems appropriate to attempt a broad assessment of airliner markets of the nineteen-sixties, and the factors influencing Britain's share in them.

It seems such a short while ago (just over two years) that the Brave New World of big jet operations was ushered in, that the outside observer may be pardoned for feeling a sense of anti-climax at the inevitable lull in jet and turboprop orders while the airlines absorb the impact—and in some cases the losses—associated with the introduction of the first generation turbine transports. But this feeling of anti-climax is unlikely to be shared in design offices in America, Britain, France or Holland—and, presumably, in Russia—for never has there been such a variety of turbine-powered airliner projects in hand, some, but by no means all, supported by firm orders.

Whereas in the first half of the past decade this country enjoyed a monopoly in the supply of turbine-powered airliners, we failed to consolidate and maintain our initial lead, and to the existing challenge from the U.S. West Coast, France and Holland, must be added future challenges from Germany and Japan. Perhaps the biggest unknown of all is the competitive impact of Russian airliners, particularly any supersonic ones that may appear.

The Vickers Vanguard—now in service but so far ordered by only two airlines.

The real danger for this country lies not so much in failing to overtake the Americans as in being outpaced by France, in particular among the Common Market countries. American commercial and technical achievement seems to have had an unfortunately mesmeric influence on our aviation policies, which are unhealthily biased in the direction of sheer, gargantuan size achieved by enforced industrial regroupings and airline mergers. By contrast, some of the most saleable French aircraft are small types designed by small firms: the Max Holste Broussard and the Super Broussard, in which Ansett-A.N.A. has an interest, come to mind immediately, as do the Alouette and Djinn helicopters.

The Caravelle and Friendship (again aircraft of moderate size) are not the only Common Market products that have attracted the attention of Commonwealth airlines. There is also the twin-engined Dornier Do 28, five of which have, it is reported, been ordered by the South African operator Protea Lugdiens, which already has a Dornier Do 27. Even in America, land of industrial giants, the success of the Aero Commander, started as a spare-time project in December, 1944, by a small group of engineers and whose production is now nearing the 1,000 mark, proves that there is still room for the small firm with ideas and technical ability, and that there is no special magic about size.

Future products of the Beagle company should go far towards recapturing for this country the markets represented by small Commonwealth outback operators, such as Carrot River Airways in Northern Saskatchewan or Barrier Air Taxi Service of Broken Hill, N.S.W., equipped with a handful of U.S. lightplanes.

Taking Our Time

Supersonic air travel is the big unknown of today, just as turboprop and jet travel was 10 years ago. But in the early post-War years we were so far behind the Americans in being able to offer really competitive equipment to the World's airlines that we could afford to take our time in catching up by applying the gas turbine to commercial transport aircraft. Eight years elapsed between the Brabazon Committee Type IIB requirement of March, 1945, for a "24-seat aircraft, powered with four gas-turbine engines driving airscrews for European and other short-to-medium range services," and the introduction of the Viscount—which resulted from that requirement—into service by B.E.A. on Apr. 19, 1953. And yet this period of time is only slightly less than that generally accepted as being the optimum gestation period for the supersonic airliner, which will be a much more difficult and expensive task than the marrying of what was then a new type of aero-engine to the already well-developed low-wing all-metal pressurized monoplane formula.

Not only was time on our side during the 1946-53 period, but—perhaps even more important—there were no significant competitive pressures from other countries, particularly America, simultaneously engaged in applying the gas turbine to airline use. Indeed, the inability of the U.S. aero-engine industry to come up with a commercially acceptable turboprop until long after the Dart had proved itself meant that the first U.S. turboprop services (with Eastern Air Lines' Electras) did not begin until January, 1959, nearly six years after Europeans were first able to avail themselves of this form of propulsion. But although we were also six years ahead of the Americans in introducing pure-jet services, the Americans certainly intend to be the first, if possible, with a supersonic airliner.

At the same time, this country and France will almost certainly be tackling a similar project, which could be either a joint European effort or, perhaps, even a European-American affair. International co-operation in this field is desirable because it will reduce the risk of competitive pressures leading to panic decisions and the wrong answers, but the ideal of such co-operation runs contrary to national prestige, the most compelling argument in favour of supersonics.

Whatever the degree of international co-operation the supersonic airliner may command, there can be little doubt that competition between airliner manufacturers in the subsonic

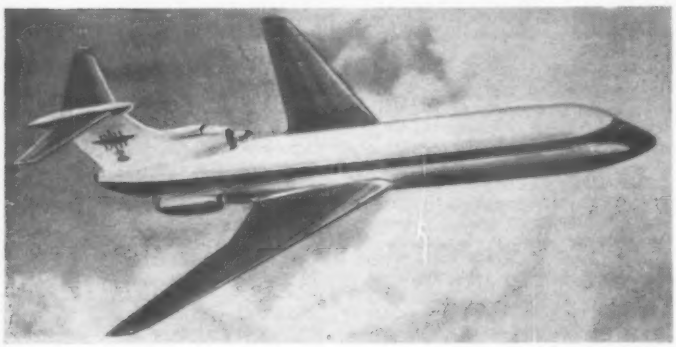
The Avro 748—ordered by three airlines and an air force, but with a long way to go before it can claim to be a successful DC-3 replacement.

field—not only between those of the non-Communist world, but between the latter and Russia—is going to be very much greater than in the previous decade.

Reasons For American Ascendancy

The long American ascendancy in World airliner markets will be met by a truly European (as distinct from a British only) challenge, and an Asiatic challenge as well. What exactly is the reason for American ascendancy? If the answer can be given in one word, it is "competition." It is a remarkable fact—and one whose significance does not seem to be properly appreciated—that of some 5,500 transport aircraft over 20,000 lb. gross weight currently in airline service in the non-Communist world, over 2,900 (or more than half) are types that owe their existence, either directly or in large part, to the competitive requirements of the U.S. transcontinental routes.

The aircraft in question are the DC-3, DC-4, DC-6, DC-6A, DC-6B, DC-7 and the Constellation and Super Constellation series; the DC-7B, DC-7C and L-1649A Starliner are not included in the total of 2,900 because these are essentially long-haul overwater developments of the basic DC-7 and L-1049. Similarly, neither the 707 nor the DC-8 are included,



De Havilland's second generation tri-motor Trident, ordered by B.E.A. and now facing powerful competition from the Boeing 727.

partly because of the 707's military tanker-transport ancestry and partly because it is rather a matter of conjecture whether Douglas would have gone ahead with the DC-8 if Boeing were not already proceeding with the KC-135 and 707. But it should be emphasized that both these big jets had to have transcontinental capability if they were to be sold to U.S. domestic carriers.

It can be seen that the figure of 2,900, if anything, underrates the intensively competitive nature of the U.S. transcontinental routes and their immense value as a stimulus to airliner design. Competition on these routes between American, United and T.W.A. has over the years cut the coast-to-coast time from the 20 hours and seven stops taken by United's Boeing 247Ds in 1934 to the first non-stop coast-to-coast service in 8 hours inaugurated by American DC-7s in 1953.

It is worth recalling that pool agreements are contrary to U.S. laws against cartels, and if there had been a pool agreement in the nineteen-thirties between American, United and T.W.A. that largely removed the competitive stimulus from transcontinental routes, air transport would have lost the priceless asset of a quarter of a century's continual refinement and development of airliner design.

Over much of this period (a very long one by air transport standards) the Americans have enjoyed the benefits of something which Sir George Edwards has stressed as needed for this country's aircraft industry—stability. And a vital ingredient in the American success story has been a combination of relative stability and a political environment that has always encouraged the development of vigorous and aggressive private enterprise. As a result, American airliner design has been essentially evolutionary, whereas this country has suffered from a combination of the revolutionary or leap-frog philosophy and the stop-and-start nature of post-War British aviation policies.

Control Without Responsibility

A lesson that successive Ministers of Supply never seemed able to grasp is that control implies responsibility. Nothing was more irresponsible and harmful to the industry's stability and export potential than to initiate major projects like the Brabazon, Princess, Vickers V.1000, Saunders-Roe SR.177 or Blue Streak and to cancel them just short of completion, or continue them long after they were not wanted. Lack of a feeling of responsibility, with its attendant obligation to acquire

Boeing's 727, tailored to U.S. domestic airline needs and already backed by two of the largest, United and Eastern.

at least an elementary understanding of the British aircraft industry, its *raison d'etre* and its products, was an important factor in this country's failure to consolidate its initial lead in turbine transport.

We British have never quite rid ourselves of the notion that we are a lot of kindly old duffers who somehow always manage to muddle through, while lesser breeds without the law, who have planned everything meticulously in advance, fail disastrously. This is reflected in the Government's inability to formulate a coherent aviation policy, and more specifically in its tendency to waste months, even years, toying with an advanced concept such as the Rotodyne or the Wallis Swallow variable-sweepback formula before deciding whether, and to what extent, to support it. As Dr. Johnson once wrote: "Is not a Patron, my Lord, one who looks with unconcern on a man struggling for life in the water and, when he has reached ground, encumbers him with help?"

This type of patronage will not help to sell British aircraft; nor does the absence of any firm Government plans to enable the British aircraft industry to offer credit facilities comparable to those of the Export-Import Bank. The attitude seems to be that current British turbine airliners will have an appeal as unique as the Comet, Britannia and Viscount seven years ago—a viewpoint that ignores not only the Friendship, Caravelle and other Common Market products, but Russian aircraft such as the Il-18, of which Ghana Airways has purchased six.

One of our basic policy failings has been the inability of successive Ministers to appreciate that there is a definite relationship between the size, prosperity and export potential of the British aircraft industry and the size of its home markets. The dispute over B.E.A.'s choice of the D.H.121 Trident illustrated this failing, and even now it is doubtful if the importance of a home market has really dawned on the Government, for the fundamental naïveté of rationalization was that new overseas orders could be attracted to the industry by merely enlarging the size of its existing units.

What really needed expanding were the markets themselves, and the Avro 748's adoption by the Indian Government is an encouraging sign that Commonwealth customers are prepared to accept a new British airliner that has not yet been proved operationally by a British airline; another healthy sign is the interest Australian airlines are taking in two new British medium jets, the VC11 and Hunting BAC-107, that do not yet have the backing of British orders. Lack of such backing need not necessarily cut short the career of new British airliners, and the concept of "designing for export," quite common in the nineteen-thirties with aircraft like the de Havilland D.H.86 designed for Qantas and the D.H.84 Dragon for the Iraqi Air Force and Hillman Airways seems to be coming back into fashion again.

The Government intends to support in principle the Trident, Argosy, VC10 and Super VC10: Government aid is also envisaged to underwrite tooling costs of new airliners and to finance production of a limited number beyond those for which firm orders have been placed. But it is surely unrealistic to expect public monies invested in such development and tooling costs to be recovered from subsequent sales if the independent operators are not allowed the scope to re-equip on a much more massive scale, and if the industry cannot offer really competitive credit facilities to foreign customers, Commonwealth or non-Commonwealth.

The new policy is not likely to be a success—at least from the taxpayer's point of view—unless there is a conscious attempt to relate the amount of Government support to the potential markets, both abroad and at home. If the Minister of Aviation really wants to get his money back he must be prepared to think in terms of a potential home and Commonwealth market (excluding sales to the Corporations) of, perhaps, 40 or 50 of a new British airliner. He must try to work out a *modus vivendi* for both classes of carrier,

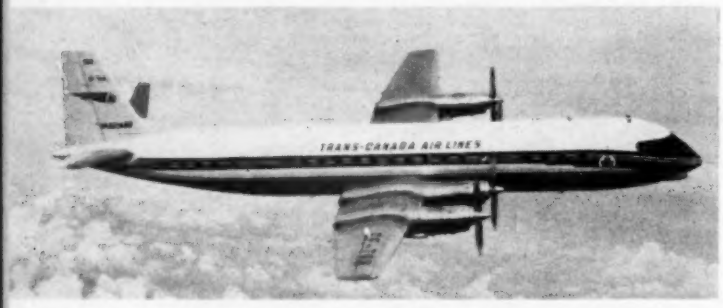
Airliner Markets of the 'Sixties

M. J. HARDY *discusses some factors influencing this country's share of future markets, the demand for cheap air travel and the significance of pooling.*

A YEAR has now passed since the process of regrouping the British aircraft industry was initiated, and the Ministry of Aviation was formed to provide that focus of authority the lack of which had been for so long recognized as a major weakness in this country's aviation policy-making. In America, Boeing, Douglas, Convair, Fairchild and Lockheed have all shown losses—in some cases heavy—on their commercial aircraft now in production, and current orders for the 707, DC-8, Fairchild F-27 and Electra have been at least two-thirds fulfilled. In this country, the last Britannia has recently been delivered to an airline, and only some nine Viscounts and 12 Comets remain to be delivered to other airlines. Of the current generation of jet transports, only Boeing 720 and Convair 880/600 deliveries are substantially less than half the existing orders, while Caravelle deliveries have just topped the half-way mark. With few sizeable new orders in prospect, now that Eastern and United have chosen the 727, and several important jet and turboprop production programmes nearing completion, it seems appropriate to attempt a broad assessment of airliner markets of the nineteen-sixties, and the factors influencing Britain's share in them.

It seems such a short while ago (just over two years) that the Brave New World of big jet operations was ushered in, that the outside observer may be pardoned for feeling a sense of anti-climax at the inevitable lull in jet and turboprop orders while the airlines absorb the impact—and in some cases the losses—associated with the introduction of the first generation turbine transports. But this feeling of anti-climax is unlikely to be shared in design offices in America, Britain, France or Holland—and, presumably, in Russia—for never has there been such a variety of turbine-powered airliner projects in hand, some, but by no means all, supported by firm orders.

Whereas in the first half of the past decade this country enjoyed a monopoly in the supply of turbine-powered airliners, we failed to consolidate and maintain our initial lead, and to the existing challenge from the U.S. West Coast, France and Holland, must be added future challenges from Germany and Japan. Perhaps the biggest unknown of all is the competitive impact of Russian airliners, particularly any supersonic ones that may appear.



The Vickers Vanguard—now in service but so far ordered by only two airlines.

The real danger for this country lies not so much in failing to overtake the Americans as in being outpaced by France, in particular among the Common Market countries. American commercial and technical achievement seems to have had an unfortunately mesmeric influence on our aviation policies, which are unhealthily biased in the direction of sheer, gargantuan size achieved by enforced industrial regroupings and airline mergers. By contrast, some of the most saleable French aircraft are small types designed by small firms: the Max Holste Broussard and the Super Broussard, in which Ansett-A.N.A. has an interest, come to mind immediately, as do the Alouette and Djinn helicopters.

The Caravelle and Friendship (again aircraft of moderate size) are not the only Common Market products that have attracted the attention of Commonwealth airlines. There is also the twin-engined Dornier Do 28, five of which have, it is reported, been ordered by the South African operator Protea Lugdiens, which already has a Dornier Do 27. Even in America, land of industrial giants, the success of the Aero Commander, started as a spare-time project in December, 1944, by a small group of engineers and whose production is now nearing the 1,000 mark, proves that there is still room for the small firm with ideas and technical ability, and that there is no special magic about size.

Future products of the Beagle company should go far towards recapturing for this country the markets represented by small Commonwealth outback operators, such as Carrot River Airways in Northern Saskatchewan or Barrier Air Taxi Service of Broken Hill, N.S.W., equipped with a handful of U.S. lightplanes.

Taking Our Time

Supersonic air travel is the big unknown of today, just as turboprop and jet travel was 10 years ago. But in the early post-War years we were so far behind the Americans in being able to offer really competitive equipment to the World's airlines that we could afford to take our time in catching up by applying the gas turbine to commercial transport aircraft. Eight years elapsed between the Brabazon Committee Type IIB requirement of March, 1945, for a "24-seat aircraft, powered with four gas-turbine engines driving airscrews for European and other short-to-medium range services," and the introduction of the Viscount—which resulted from that requirement—into service by B.E.A. on Apr. 19, 1953. And yet this period of time is only slightly less than that generally accepted as being the optimum gestation period for the supersonic airliner, which will be a much more difficult and expensive task than the marrying of what was then a new type of aero-engine to the already well-developed low-wing all-metal pressurized monoplane formula.

Not only was time on our side during the 1946-53 period, but—perhaps even more important—there were no significant competitive pressures from other countries, particularly America, simultaneously engaged in applying the gas turbine to airline use. Indeed, the inability of the U.S. aero-engine industry to come up with a commercially acceptable turboprop until long after the Dart had proved itself meant that the first U.S. turboprop services (with Eastern Air Lines' Electras) did not begin until January, 1959, nearly six years after Europeans were first able to avail themselves of this form of propulsion. But although we were also six years ahead of the Americans in introducing pure-jet services, the Americans certainly intend to be the first, if possible, with a supersonic airliner.

At the same time, this country and France will almost certainly be tackling a similar project, which could be either a joint European effort or, perhaps, even a European-American affair. International co-operation in this field is desirable because it will reduce the risk of competitive pressures leading to panic decisions and the wrong answers, but the ideal of such co-operation runs contrary to national prestige, the most compelling argument in favour of supersonics.

Whatever the degree of international co-operation the supersonic airliner may command, there can be little doubt that competition between airliner manufacturers in the subsonic

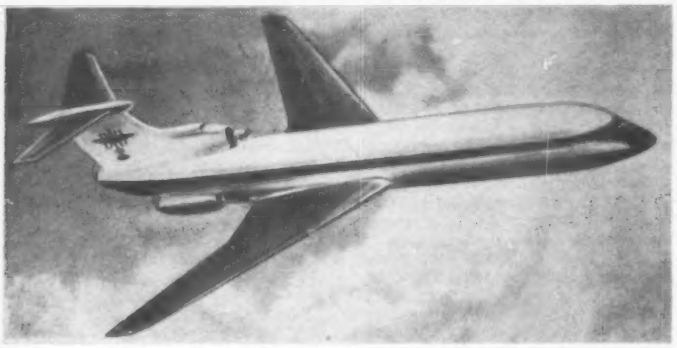
The Avro 748—ordered by three airlines and an air force, but with a long way to go before it can claim to be a successful DC-3 replacement.

field—not only between those of the non-Communist world, but between the latter and Russia—is going to be very much greater than in the previous decade.

Reasons For American Ascendancy

The long American ascendancy in World airliner markets will be met by a truly European (as distinct from a British only) challenge, and an Asiatic challenge as well. What exactly is the reason for American ascendancy? If the answer can be given in one word, it is "competition." It is a remarkable fact—and one whose significance does not seem to be properly appreciated—that of some 5,500 transport aircraft over 20,000 lb. gross weight currently in airline service in the non-Communist world, over 2,900 (or more than half) are types that owe their existence, either directly or in large part, to the competitive requirements of the U.S. transcontinental routes.

The aircraft in question are the DC-3, DC-4, DC-6, DC-6A, DC-6B, DC-7 and the Constellation and Super Constellation series; the DC-7B, DC-7C and L-1649A Starliner are not included in the total of 2,900 because these are essentially long-haul overwater developments of the basic DC-7 and L-1049. Similarly, neither the 707 nor the DC-8 are included,



De Havilland's second generation tri-motor Trident, ordered by B.E.A. and now facing powerful competition from the Boeing 727.

partly because of the 707's military tanker-transport ancestry and partly because it is rather a matter of conjecture whether Douglas would have gone ahead with the DC-8 if Boeing were not already proceeding with the KC-135 and 707. But it should be emphasized that both these big jets had to have transcontinental capability if they were to be sold to U.S. domestic carriers.

It can be seen that the figure of 2,900, if anything, underrates the intensively competitive nature of the U.S. transcontinental routes and their immense value as a stimulus to airliner design. Competition on these routes between American, United and T.W.A. has over the years cut the coast-to-coast time from the 20 hours and seven stops taken by United's Boeing 247Ds in 1934 to the first non-stop coast-to-coast service in 8 hours inaugurated by American DC-7s in 1953.

It is worth recalling that pool agreements are contrary to U.S. laws against cartels, and if there had been a pool agreement in the nineteen-thirties between American, United and T.W.A. that largely removed the competitive stimulus from transcontinental routes, air transport would have lost the priceless asset of a quarter of a century's continual refinement and development of airliner design.

Over much of this period (a very long one by air transport standards) the Americans have enjoyed the benefits of something which Sir George Edwards has stressed as needed for this country's aircraft industry—stability. And a vital ingredient in the American success story has been a combination of relative stability and a political environment that has always encouraged the development of vigorous and aggressive private enterprise. As a result, American airliner design has been essentially evolutionary, whereas this country has suffered from a combination of the revolutionary or leap-frog philosophy and the stop-and-start nature of post-War British aviation policies.

Control Without Responsibility

A lesson that successive Ministers of Supply never seemed able to grasp is that control implies responsibility. Nothing was more irresponsible and harmful to the industry's stability and export potential than to initiate major projects like the Brabazon, Princess, Vickers V.1000, Saunders-Roe SR.177 or Blue Streak and to cancel them just short of completion, or continue them long after they were not wanted. Lack of a feeling of responsibility, with its attendant obligation to acquire

Boeing's 727, tailored to U.S. domestic airline needs and already backed by two of the largest, United and Eastern.

at least an elementary understanding of the British aircraft industry, its *raison d'etre* and its products, was an important factor in this country's failure to consolidate its initial lead in turbine transport.

We British have never quite rid ourselves of the notion that we are a lot of kindly old duffers who somehow always manage to muddle through, while lesser breeds without the law, who have planned everything meticulously in advance, fail disastrously. This is reflected in the Government's inability to formulate a coherent aviation policy, and more specifically in its tendency to waste months, even years, toying with an advanced concept such as the Rotodyne or the Wallis Swallow variable-sweepback formula before deciding whether, and to what extent, to support it. As Dr. Johnson once wrote: "Is not a Patron, my Lord, one who looks with unconcern on a man struggling for life in the water and, when he has reached ground, encumbers him with help?"

This type of patronage will not help to sell British aircraft; nor does the absence of any firm Government plans to enable the British aircraft industry to offer credit facilities comparable to those of the Export-Import Bank. The attitude seems to be that current British turbine airliners will have an appeal as unique as the Comet, Britannia and Viscount seven years ago—a viewpoint that ignores not only the Friendship, Caravelle and other Common Market products, but Russian aircraft such as the Il-18, of which Ghana Airways has purchased six.

One of our basic policy failings has been the inability of successive Ministers to appreciate that there is a definite relationship between the size, prosperity and export potential of the British aircraft industry and the size of its home markets. The dispute over B.E.A.'s choice of the D.H.121 Trident illustrated this failing, and even now it is doubtful if the importance of a home market has really dawned on the Government, for the fundamental naïveté of rationalization was that new overseas orders could be attracted to the industry by merely enlarging the size of its existing units.

What really needed expanding were the markets themselves, and the Avro 748's adoption by the Indian Government is an encouraging sign that Commonwealth customers are prepared to accept a new British airliner that has not yet been proved operationally by a British airline; another healthy sign is the interest Australian airlines are taking in two new British medium jets, the VC11 and Hunting BAC-107, that do not yet have the backing of British orders. Lack of such backing need not necessarily cut short the career of new British airliners, and the concept of "designing for export," quite common in the nineteen-thirties with aircraft like the de Havilland D.H.86 designed for Qantas and the D.H.84 Dragon for the Iraqi Air Force and Hillman Airways seems to be coming back into fashion again.

The Government intends to support in principle the Trident, Argosy, VC10 and Super VC10: Government aid is also envisaged to underwrite tooling costs of new airliners and to finance production of a limited number beyond those for which firm orders have been placed. But it is surely unrealistic to expect public monies invested in such development and tooling costs to be recovered from subsequent sales if the independent operators are not allowed the scope to re-equip on a much more massive scale, and if the industry cannot offer really competitive credit facilities to foreign customers, Commonwealth or non-Commonwealth.

The new policy is not likely to be a success—at least from the taxpayer's point of view—unless there is a conscious attempt to relate the amount of Government support to the potential markets, both abroad and at home. If the Minister of Aviation really wants to get his money back he must be prepared to think in terms of a potential home and Commonwealth market (excluding sales to the Corporations) of, perhaps, 40 or 50 of a new British airliner. He must try to work out a *modus vivendi* for both classes of carrier,

allowing independent re-equipment on a much larger scale, and with brand-new (as distinct from second-hand) aircraft with which the independents have some prospect of attaining an economical utilization.

We could learn much from the French concept of partnership, rather than rivalry, which has been carried to the point where France will be able to offer the first round-the-World jet service operated jointly by an independent and a State airline. T.A.I. DC-8s at present fly from Paris to Noumea, where their DC-7s take over for the flight to Los Angeles; Air France 707s fly back from Los Angeles to Paris via Montreal. And it is worth noting that overseas independents, given the opportunities, have shown themselves to be a useful market for modern British airliners: in 1949 Canadian Pacific was the first overseas airline to order Comets, and U.A.T. was another early Comet operator. Transcontinental took delivery of two Britannias to meet Comet competition from Aerolineas Argentinas on the Buenos Aires-New York route, and Canadian Pacific's eight Britannias operate, amongst other routes, a Canadian transcontinental service in competition with Trans-Canada Air Lines.

Broadening the Appeal

Any suggestion of independent expansion will meet with the familiar cry: "We must not undermine the Corporations' competitive positions." There is a sinister, conspiratorial ring about that word "undermining" that hints darkly of the economic anarchy that independent competition—especially with very low fares—would bring.

To put things in perspective, it is salutary to recall that within the past 18 months at least two carriers operating low-fare services have gone bankrupt: CINTA-ALA in Chile, which operated cut-price services from Santiago to Havana, and Transocean Air Lines. The latter operated low-fare, low-frequency services across the U.S.A. and Pacific with ex-B.O.A.C. Stratocruisers, offering a single New York-San Francisco fare of only $80 and, in addition, did a good deal of contract charter work. Transocean's fleet of 14 Stratocruisers, at least five still bearing their British registrations, were sold as scrap in September for a mere £37,500, less than 1% of their original value. A third low-fare carrier, Aerolineas Peruanas S.A., has had to cancel an order for two Electra turboprops because the necessary financing could not be arranged.

Low-cost air transport is far from being the piratical, get-rich-quick affair that its detractors assume, and Transocean's demise in particular points the moral that to be really effective against strong jet competition this type of service demands equipment especially designed to operate as cheaply as possible, as fares perhaps 50% below existing jet fares instead of 20% or so. As Mr. Peter Masefield has pointed out, no carrier has ever asked a manufacturer to design an airliner to operate as cheaply as possible: it is surely time to stop thinking in terms of "undermining" and start thinking in terms of new equipment that will broaden the appeal of air transport far beyond the expense-account travel markets for which the supersonic airliner is intended.

The broader air transport's appeal, the more easily will this industry be able to afford and absorb massive investments in supersonics; faster-than-sound travel at premium fares and low-cost air transport in propeller-driven aircraft are surely complementary rather than contradictory.

Monopolist Morality

In this country, at any rate, this viewpoint does not seem to command general acceptance. Any proposal that one of the British independents be allowed to operate in direct competition with the Corporations (as distinct from pooling of services) has generally raised the objection that the independent in question "is not strong enough" and should not, therefore, be permitted to try its hand. One finds the logic of this argument hard to understand because it gives the independents credit for being at the same time too competitive and not competitive enough. Too competitive, because they threaten to skim away some traffic from the existing carriers; not competitive enough, because their equipment is insufficiently modern and their sales and traffic handling facilities along the routes in question undeveloped.

In other words, lack of strength is too often confused with lack of opportunity, and the "not strong enough" argument reminds one irresistibly of the words of Alfred P. Doolittle in "My Fair Lady": "I'm one of the undeserving poor, that's what I am. Think what that means to a man. It means he's up agenst middle-class morality all the time. If there's anything going and I put in for a bit of it, it's always the same story: you're undeserving, so you can't have it."

No reasonable person would expect the independents to be allowed unlimited freedom of competition with the Corporations. But it is not merely the independents themselves that are up against the monopolist morality which, expressed in pool agreements, is still so prevalent in air transport. An example of this is the B.O.A.C./Qantas/Air India pool stipulation which excludes British independent competition on the Eastern and Australian routes—and with it a slice of the potential home market for current British airliners.

The travelling public, too, will tend to suffer increasingly from monopolist morality, in the sense that large-scale pooling, by removing the competitive stimulus between airlines and tending towards a relaxation of sales efforts, will deprive the public of the benefits of competition, particularly in the field of low-cost transport. Referring to pool agreements, the Indian Deputy Minister of Civil Aviation has gone on record as saying: "The basic idea is to eliminate competition between both airlines" (i.e., B.O.A.C. and Air India). What could be plainer?

It has been argued in their favour that pool agreements tend to slow down the re-equipment race by discouraging over-investment in expensive new aircraft. But such evidence as is available suggests rather the contrary: pools might be used to "support" a particularly advanced or competitive type of aircraft in the early days of its career when public acceptance is still rather an unknown and the risk of mechanical troubles and revenue losses is always present.

It is significant that until 1952 B.E.A. had no pool agreements with its competitors; it was with the introduction of Elizabethans, and especially Viscounts, that this practice started to become more and more widespread, until today all 17 of B.E.A.'s competitors now operate in pool with the Corporation. Again, the B.E.A./Air France pool agreement of February, 1959, on the London-Paris and London-Nice routes was doubtless motivated at least partly by the impending introduction of Caravelles on those routes that summer.

Not every pool agreement is the direct result of re-equipment: paradoxically enough, introduction of a highly competitive new type by one of two carriers operating between each other's country may attract so much traffic away from the carrier with less competitive equipment that the latter requests the essentially non-competitive pooling arrangement to protect its competitive position. So competition, instead of being stimulated by advances in technology, tends to be cancelled out. Re-equipment can lead to pooling rather than vice versa, but the quite phenomenal growth of pooling in the past year or so may start a dangerous trend in which new aircraft—particularly supersonic ones—are ordered in the knowledge that pooling will tend to protect the carrier from the consequences of a wrong decision.

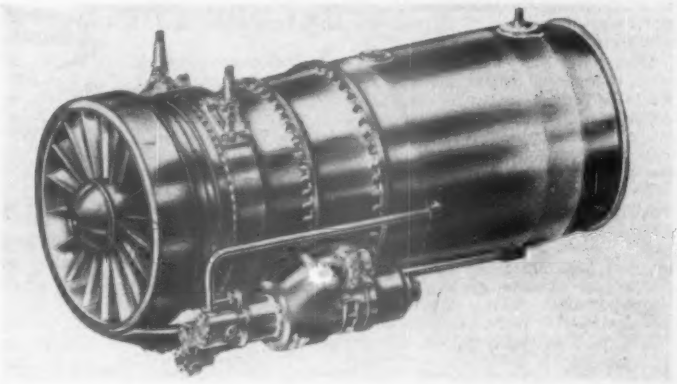
Air transport will tend to become less a mode of conveying people and things, less a process in which the consumer, by exercising his freedom of choice, can influence the producer into giving him what he wants. It will tend to become with supersonics more a receptacle or show-case for highly advanced and very expensive aerodynamic and structural techniques, for a field of technology which the public does not want, and whose benefits only a small minority of them will ever be able to afford.

Governments may want supersonic travel for reasons of national prestige and to maintain full employment in their aircraft industries as the demand for manned military aircraft decreases; airlines will want it because their competitors or, if not their competitors, the Russians, want it as well. But public demand must be taken into account or else the result will be commercially, if not technically, catastrophic.

Vickers VC10—Britain's bid for a share of the subsonic big-jet market and progenitor of a family of designs. One customer so far.

Bristol Siddeley's Civil Turbofan

Details of the BS.75



IF a short- or medium-range jet transport is to replace current turboprop airliners, it must have lower operating costs. This is why Bristol Siddeley are developing their new small turbofan, the BS.75; it has been designed to power such aircraft as the BAC-107 and Avro 771. These projected short-haul airliners are very similar in concept, both weighing about 50,000 lb. and carrying 60 passengers, and both powered by two rear-mounted BS.75 engines.

A considerable sales effort has been devoted to the BAC-107, which is designed to cruise at 440 knots and carry its maximum payload over a still-air range (with reserves) of about 500 nautical miles. Bristol Siddeley and British Aircraft Corporation sales teams have visited some 50 airlines to give detailed information about the BAC-107.

The BS.75 was originally conceived in the early part of 1959, as the result of a Bristol Siddeley study of the probable engine requirements of the short/medium range aircraft which would be needed by airlines in 1965 and onwards. The basic design was completed in September, 1959, and shortly afterwards it was selected by the British Aircraft Corporation to power the BAC-107.

This aircraft, previously known as the Hunting 107, had been designed originally with Bristol Siddeley Orpheus engines. At the time, these were considered very suitable for a short-haul transport. But although their weight was very low, by current standards, their fuel consumption was fairly high. Further study by the British Aircraft Corporation of the operating costs and performance of the Hunting 107 showed that both would be greatly improved if the BS.75 were used instead of the Orpheus.

The BS.75 has a by-pass ratio of 1.75 : 1. Design figures show how great an improvement it offers over the Orpheus, particularly in fuel consumption. Its take-off thrust is 7,550 lb., compared with 6,810 lb. for the comparable Orpheus, the B.Or. 12; the respective specific fuel consumptions are 0.508 and 0.967 lb./lb./hr.

At a dry weight of 1,525 lb. the BS.75 is 345 lb. heavier than the B.Or. 12, but, despite a high by-pass ratio, its intake diameter of 33.4 in. is only 1 in. greater. Its cruise fuel consumption at Mach. 0.75 and 30,000 ft. is 0.76 lb./lb./hr., which compares extremely favourably with 0.93 lb./lb./hr. for the B.Or.12.

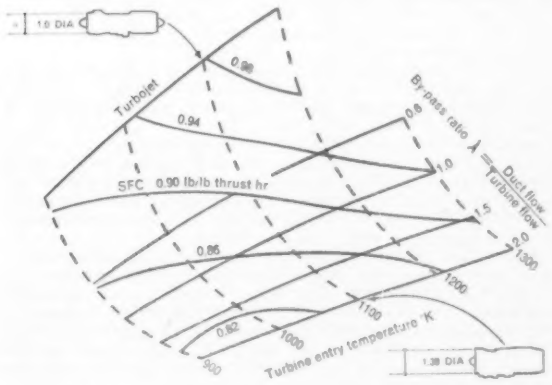
A further advantage is the much lower noise level expected from the new engine. It is claimed that a turbofan engine of this ratio is likely to be 15 db. quieter than a turbojet of the same thrust.

The BS.75 is being developed by Bristol Siddeley as a private venture. As already mentioned its basic design was completed in September, 1959, and its installation features for the BAC-107 were fixed in June this year. Rig tests of components began last June and the first engine run is scheduled for January, 1962. Engines for a prototype aircraft will be available a year later and civil certification of the engine is expected by June, 1964.

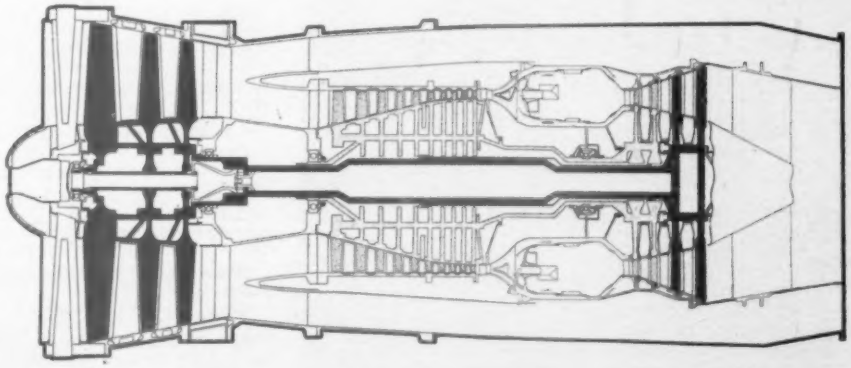
Turbofan Studies

Bristol Siddeley studies have shown that direct operating costs of an aircraft and its engine-plus-fuel weight decrease as the engine by-pass ratio is increased to 2 : 1. Increases in nacelle drag with by-pass ratio, and possibly in engine weight, do not outweigh the advantages that are to be gained in having a high ratio.

For cruise conditions there is little s.f.c. advantage in increasing the by-pass ratio above 1.5, but stand-off and diversion flight may account for up to 30% of the fuel load of a short-haul transport. At these lower speeds the s.f.c. improves with



FUEL ECONOMY.—This Bristol Siddeley diagram shows how varying the by-pass ratio and turbine entry temperature of a turbojet affects its specific fuel consumption; it also indicates how much the engine diameter increases with by-pass ratio. A fixed overall pressure ratio of about 12:1 is assumed; the s.f.c.s apply to flight at 500 kts. at the tropopause (36,089 ft.).



INSIDE THE BS.75.—Two-spool layout of the BS.75 is clearly shown in this drawing of the engine's internal construction.

by-pass ratios up to 2 : 1. These facts led to the choice of a 1.75 by-pass ratio for the BS.75.

Another factor influencing choice of by-pass ratio was noise. As this ratio increases, the jet noise of an engine lessens, but its intake noise increases; the noise levels in PNdb for an engine of BS.75 size are equal to a ratio just above 1.8 : 1.

These reasons lie behind the choice of a particular value of by-pass ratio for the BS.75. But Bristol Siddeley feel there is no magic about the value chosen. When the engine is up-rated, more air will be passed through the H.P. compressor and the by-pass ratio will come down.

Indeed the team feels that undue technical controversy has been engendered about the choice of ratio. In general, the choice is only a matter of degree and companies are tending towards similar ratios. It is not a case of choosing between two entirely different technical solutions, as with many long-forgotten controversies such as the argument about the relative merits of axial and centrifugal compressors.

The design of the BS.75 has been influenced by the far-reaching commercial guarantees which Bristol Siddeley is offering to its operators. As a result of these, and of its civil engine design policy generally, the company has chosen the simplest possible layout for the engine and designed the components to operate within the limits of its experience with current engines. Many engine components are closely related to those used in earlier Bristol Siddeley engines.

For the first two years of airline operation Bristol Siddeley is prepared to guarantee maximum overhaul costs for the engine. A minimum life of 2,000 hr. is guaranteed for hot components and 4,000 hr. for other main parts of the engine.

The engine is expected to enter service with an overhaul life of 500 hr., subject to sampling; this assumes that 6,000 engine hours will have been built up by then, including intensive route trials. By the time 250,000 engine hours have been completed an overhaul life of 2,000 hr. is expected. This is in line with Bristol Siddeley civil experience with the Proteus turboprop.

The Engine in Detail

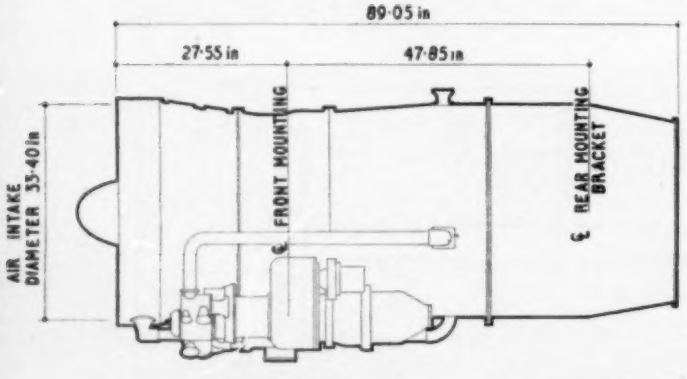
The BS.75 is a two-shaft turbofan; its three-stage L.P. fan is driven by a two-stage L.P. turbine. The fan has a 1.85 : 1 pressure ratio. Fan flow is split in the ratio of 1.75 : 1, the greater part travelling via a by-pass duct to the propelling nozzle. The remainder of the fan flow supercharges the 10-stage H.P. compressor, which is driven by a two-stage H.P. turbine.

H.P. and L.P. shafts are coaxial, their maximum rotational speed being 14,500 r.p.m. The H.P. compressor has a 7 : 1 compression ratio, giving an overall compression ratio of about 13 : 1. An annular combustion system is used.

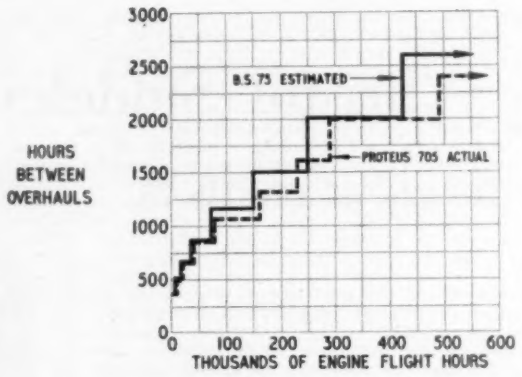
A three-stage, rather than a two-stage, fan was chosen in order to reduce blade loadings. The fan is similar in design to the first three compressor stages of the Olympus 201 which is in production for the Avro Vulcan, but it is of lower diameter because of the lower mass flow of 190 lb./sec. This marks a reversion from the two-stage fan chosen for the BS.53; the change was made to reduce aerodynamic and stress limits on the BS.75 fan blades.

The 10-stage H.P. compressor is new, but is basically a scaled Orpheus compressor to which three additional stages have been added. Initially it will be run at 90% of Orpheus compressor speed, leaving a 10% margin available to increase efficiency and as a reserve for engine up-rating.

Orpheus stage loadings have been reduced to improve efficiency. The pressure ratio of 7 : 1 compares with 4.4 : 1



DIMENSIONS.—Although its by-pass ratio is 1.75 : 1, diameter of the BS.75 is only one inch greater than that of the Orpheus B.Or.12 which is a pure turbojet of slightly lower thrust.



OVERHAUL LIFE.—Estimated increases in overhaul life for the BS.75 are compared with those achieved for the Proteus 705 turboprop.

for the Orpheus 803. Variable-incidence guide vanes and first-stage stators are used on this compressor, and there is inter-stage bleed.

The annular combustion chamber is uncommon in civil engines, but has been chosen following experience with the annular system of the Sapphire and cannular system of the Olympus. It is reckoned that the best potential for long life lies with the annular system. The BS.75 system is, in fact, based on the Sapphire combustion chamber.

Design of the two-stage H.P. and L.P. turbines is derived from the Proteus 705 turbines, although the BS.75 has a higher pressure ratio. The turbines for both engines are similar in size, operating temperature and blade stresses, and the same materials and techniques will be used in their construction. Turbine entry temperature for the BS.75 will be 1,200°K. at take-off.

The choice of blade material and operating temperature is very important for the engines of a short-haul aircraft, because they spend a relatively large part of their running time at take-off rating. Turbine blade temperatures will be no higher than those currently used on the Proteus, and the blade materials are being cleared for a take-off temperature 40°C. above that specified for the BS.75. A conservative choice of operating temperatures allows the overhaul life to be forecast with reasonable confidence.

The H.P. compressor and turbine shaft is supported on two bearings and there are no couplings or intershaft bearings. This reduces complexity and eliminates a potential source of trouble.

Bristol Siddeley has considerable experience of A.R.B. and F.A.A. certification requirements for civil engines following its introduction of the Proteus turboprop. Blade-containment and turbine-disc integrity tests will be made for the BS.75. Systems are incorporated in the engine to give full overspeed protection and warning of thrust-bearing failure.

The rig test programme for the engine—started seven months ago—will continue for about two years. Tests will be made of the L.P. compressor (the fan), the H.P. compressor, the combustion chamber, the L.P. fan and the thrust reverser.

Experience with the BS.53 lift/thrust turbofan will prove very useful in the development of the BS.75. The former engine powers the Hawker P.1127 V/STOL strike aircraft, hovering trials of which have been in the news lately.

As mentioned, engine noise was an important factor in the design of the BS.75. Bristol Siddeley consider that its s.f.c. could have been approached using a lower by-pass ratio, but only by designing a high pressure-ratio engine with a consequent increase in the number of stages, complexity and weight. But this engine would have had a higher jet velocity than the BS.75, and thus been noisier. The BS.75 represents the best compromise.

BS.75 Technical Data

Layout.—Civil turbofan of 1.75:1 by-pass ratio. Three-stage fan of 1.85 : 1 pressure ratio; 10-stage H.P. compressor, 7 : 1 pressure ratio; overall pressure ratio, 12.95 : 1; annular combustion chamber; two-stage H.P. and L.P. turbines. Mass flow, 190 lb./sec.

Dimensions.—Intake diameter, 33.4 in.; length, intake flange to exhaust flange, 89.05 in.

Weight.—Dry, 1,525 lb.

Performance.—Guaranteed minimum take-off thrust, I.S.A., sea level, 7,550 lb. at s.f.c. 0.508 lb./lb./hr.; cruise thrust (Mach. 0.75 at 30,000 ft.), 2,530 lb. at s.f.c. 0.760 lb./lb./hr.

The Fighting Services

V-Bomber Escape

IN view of the experience and low accident rate over the five years that V-bombers have been in service with Bomber Command and of the considerable time, effort, disruption and cost which would be involved in aircraft modification, the Air Council has decided that the provision of ejection seats for the three rear crew members cannot be justified.

The new and presumably final decision on the subject of such escape aids for all Victor, Vulcan and Valiant crew members was obviously a very difficult one to make. For although such an ejection seat installation is complicated by the comparatively extensive pressure cabin structural changes which would be necessary, the technical possibility of such an escape aid was proved last July by the live ejection with a Martin-Baker rearward-facing ejection seat.

This trial, which took place over Chalgrove at 1,000 ft. and 250 knots, was made from an M.o.A. Valiant flown by the Bomber Command Development Unit and was watched by senior Service officers and M.o.A. officials.

False Missile Warning

AIR MARSHAL R. SLEMON, R.C.A.F., has been credited with averting a major nuclear alert in North America on Oct. 5, 1960, after a false missile launching report from the early warning radar station at Thule, Greenland.

As Deputy Commander of the North American Air Defense Command, Air Marshal Slemon was in the "hot seat" at NORAD Headquarters, Colorado Springs, when radar information from Thule showed that long-range missiles had been launched against North America. He ordered an immediate check and in approximately one minute it was found that the signals could not be confirmed through any other warning source. It was later reported that the radar station had a fault which caused it to pick up its own signals which had been reflected from the moon.

This incident is believed to have been the first such missile scare. Air Marshal Slemon acted so quickly that no alert was flashed to Strategic Air Command missile and bomber bases.

He has been Deputy Commander of NORAD since the combined United States-Canadian command was established in 1957. Before that he was Chief of the Canadian Air Staff for nearly five years.

Overseas Postings

FORTY R.A.F. officers destined to be posted overseas between now and next September will be attending special courses of lectures designed to familiarize them with the different conditions they will encounter in the countries to which they are going. The Air Ministry has arranged for them to take the courses as an experiment, and a number have already attended since they began last September. After they have been some time overseas they will be asked to report on the value of the courses.

Those taking the courses first assemble at the offices of the Commonwealth Institute in South Kensington, then proceed to one or other of Overseas Service's two country houses at Dunford College, Midhurst, and Moor Park College, Farnham. There personnel attend lectures given by specialists, and see films on a variety of aspects of life overseas.

Antarctic Flight Disbanding

FOLLOWING the loss of its Dakota and a Beaver last month in one of the worst blizzards ever experienced in the Antarctic, the 1960-61 R.A.A.F. Antarctic Flight will be disbanded on Jan. 9. However, Sqn. Ldr. N. F. Ashworth, who has been selected as the leader of the 1961-62 Flight, will go to the base at Mawson when the relief ship leaves Melbourne to bring the members of the present Flight back to Australia.

During the blizzard the wind blew for hours at 80 m.p.h., reaching 116 m.p.h., over the ice plateau. A 15-ton cable tying down the Dakota broke inside the ice and the aircraft was blown 10 miles away where it was found badly damaged. The Beaver's tiedown cables withstood the blizzard, but the aircraft broke into pieces. Its back was broken and the wings were torn off.

During the rescue operations, personnel were lifted bodily into the air and carried several yards; they slid helplessly over the ice until rescued. Only by holding on to each other could they prevent themselves from being blown away with parts of the wrecked Beaver they were trying to save.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Wg. Cdr. A. P. H. Slogrove to the Department of the Air Member for Supply and Organization.

Bomber Command: Wg. Cdr. W. M. Dixon, D.S.O., D.F.C., A.F.C., to R.A.F. Feltwell to command, and Wg. Cdr. J. Finch, O.B.E., D.F.C., A.F.C., to R.A.F. Waddington to command, both with acting rank of Gp. Capt.

Fighter Command: Wg. Cdr. P. J. Simpson, D.S.O., D.F.C., to R.A.F. Stanmore as Air Defence Controller, with acting rank of Gp. Capt.

Transport Command: Sqn. Ldr. W. G. Carr, M.B.E., to Headquarters, No. 38 Group, for administrative planning duties, with acting rank of Wg. Cdr.

Coastal Command: Gp. Capt. P. R. Casement, D.S.O., D.F.C., A.F.C., to the R.A.F. Element, the Joint Anti-Submarine School, Londonderry, as R.A.F. Director.

Flying Training Command: Gp. Capt. T. P. Seymour to the R.A.F. College, Cranwell, as Assistant Commandant.

Maintenance Command: Wg. Cdr. L. R. Flower, M.B.E., M.M., to No. 23 Maintenance Unit, Calshot, to command.

R.A.F. Germany: Gp. Capt. C. S. G. Stanbury, D.S.O., D.F.C., A.F.C., to R.A.F. Laarbruch to command; Wg. Cdr. N. E. Bowen to R.A.F. Sylt to command the Flying Wing; Sqn. Ldr. H. H. Dent to R.A.F. Butzweilerhof to command the Forward Repair Unit.

Middle East Air Force: Gp. Capt. C. W. S. Jones to Headquarters as Command Account Officer.

Far East Air Force: Wg. Cdr. J. R. C. H. Graves to R.A.F. Seletar to command the Flying Wing.

Other Appointments: Wg. Cdr. D. Le R. Bird to the British Defence Staff, Washington; Wg. Cdr. E. B. Loftus, O.B.E., to the Ministry of Aviation, with acting rank of Gp. Capt.; Wg. Cdr. W. A. Griffiths, D.F.C., to Budapest as Air Attaché, with acting rank of Gp. Capt.

More Service News

No. 8 Squadron History.—No. 8 Squadron at R.A.F. Khormaksar, B.F.P.O. 69, is sadly deficient in records of its history. Present Squadron personnel would be very grateful to past members and friends for any documents, information and especially photographs that they could supply to remedy this situation.

R.A.F. Sylt.—The 2nd T.A.F. air firing training base at Sylt is to be handed over to the West German Air Force on Oct. 16, 1961. German pilots have taken part in the training programme at Sylt since August, 1958, and the move is part of a gradual process to return 2nd T.A.F. bases to the West German A.F.

R.A.A.F. Appointment.—Air Vice-Marshal D. A. J. Creal, C.B.E., has become R.A.A.F. Air Member for Supply and Equipment in succession to Air Vice-Marshal H. G. Acton, C.B.E., who has retired from the Service.

WINGS PRESENTATION.—Last month H.R.H. Prince Chula Chakrabongse of Thailand visited R.N.A.S. Culdrose and presented "wings" to a graduating course of Naval helicopter pilots. H.R.H. was flown from his residence near Bodmin by a Dragonfly of the Search and Rescue Flight and escorted to the air station by two Wessex HAS.1s of No. 700 "H" Flight.

Distinguished guests arrive at Santiago on B.O.A.C.'s inaugural Comet service to Latin America, in January.

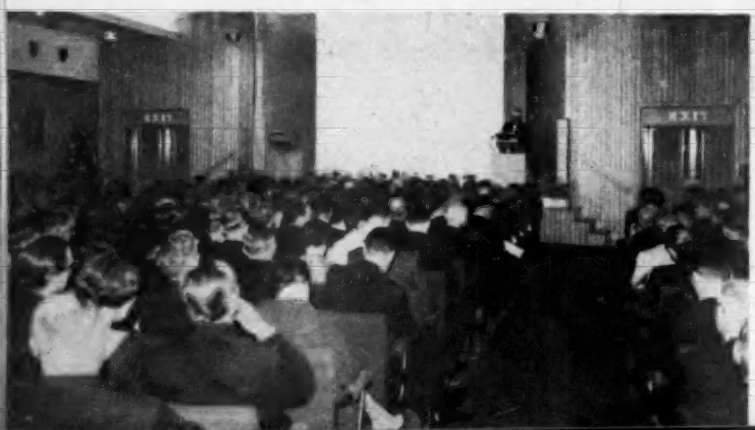
H.M.S. "Bulwark" joined the Fleet as a Commando carrier equipped w Westland Whirlwind helicopters powered by Alvis Leonides Majors.

In July, the President of the Argentine Republic paid a State visit to the U.K.; he travelled from Holland to Gatwick in a Handley Page Herald (two Rolls-Royce Darts).

Sqn. Ldr. J. Severne won the King's Cup in a Rollason Turbulent (Ard flat-four) entered by the Duke of Edinburgh; he also became the 1 British Air Racing Champion.

In June, Her Majesty the Queen became Commandant-in-Chief of the R.A.F. College, Cranwell, and in July visited the College to review the passing-out parade of No. 77 entry.

One of the features of the S.B.A.C. Display was a demonstration by English Electric Lightnings (Rolls-Royce Avons) in full squadron markings.



Left, a highlight of the Royal Aeronautical Society's year was the opening of its new lecture hall at 4 Hamilton Place, London, W.1.

1960 in Retrospect

—*Some of the Highlights*

In April the Short SC.1 experimental VTOL aircraft (five Rolls-Royce RB.108s) made its first transition flight at R.A.E. Bedford; later it "stole" the S.B.A.C. Show.

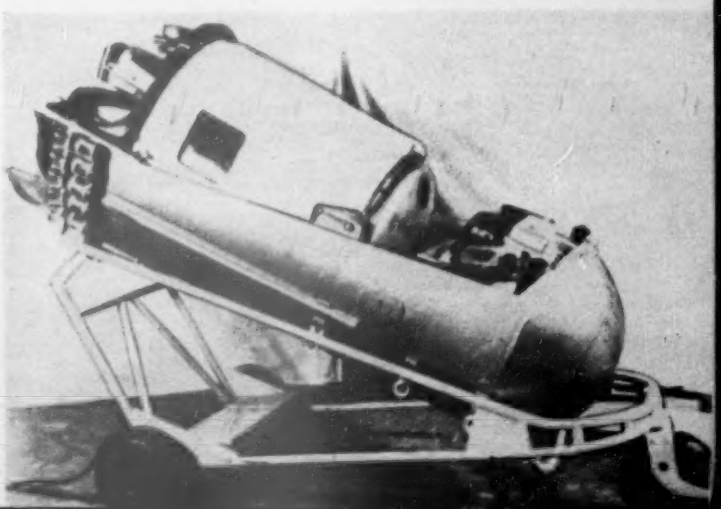
A notable event at Woodford in July was the first flight of the Avro 748 feeder liner (two Rolls-Royce Darts).

Above, the Hawker P.1127 VTOL fighter made its debut at Dunsfold; it is powered by a Bristol Siddeley BS.53 lift/thrust turbojet.

Outstanding astronautical event of the year was Russia's recovery from orbit of the Sputnik V capsule containing two dogs.

Above, the first three Westland (Bristol) Belvederes for the R.A.F. were formally handed over in October; they are powered by Napier Gazelles.

Below, the Vickers Vanguard (four Rolls-Royce Tynes) received its C. of A. in December.



U.S. Anti-submarine Reserves

WHEN one thinks of American strength, one tends to think of the Strategic Air Command or, perhaps, the expanding number of missile bases. The great size of the supporting forces was vividly drawn to our attention during a recent visit to the U.S. Naval Air Station at Grosse Ile, a residential suburb of Detroit. Relics of its Wartime rôle as a Fleet Air Arm training base are still evident.

Devoted entirely to Naval and Marine Air Reserve operations, this base houses 34 units and 1,700 men. Seventeen other similar stations, mostly in coastal cities, give the Naval Air Reserve an impressive 400 squadrons and 30,000 men. And this in spite of a budget cut which closed nine major air bases in 1958-59.

This entire force is being concentrated on anti-submarine warfare, losing many of its jet fighter and attack squadrons to meet the challenge posed by over 450 Russian submarines.

In contrast with some Commonwealth auxiliary air forces, the U.S. Naval Air Reserve is equipped with the most modern aircraft. P2V-5F Neptunes (up-dated with jet engines), S2F-1 Trackers, Sikorsky HSS anti-submarine helicopters and the well-liked, although older, AD-5 Skyraider are standard. The rather uncommon Super DC-3 (disguised as the R4D-8) and the Beechcraft JRB are used for communications. Some of the remaining jet squadrons have the A4D Skyhawk and Sidewinder air-to-air missiles.

Each year one squadron from each of the 18 air stations undergoes summer training at Port Lyautey, Morocco.

Recently the reserves worked on an equal footing with the regular Navy in two major exercises, the largest of their kind. These were forerunners of on-the-job training, now under way, for the Selective Reserve, a force within the Naval Air Reserve ready for immediate call to duty.

Men of the Selected Reserve carry on their persons orders detailing their postings in the event of a national emergency. They hope to have their ASW squadrons at coastal duty stations within six hours of an alarm, thus freeing regular-force units for carrier-borne service.

To save time, reserve squadrons are not trained in carrier landings. Instead the emphasis is on teamwork and the performance of specific duties. During the recent Atlantic exercise, reserve Tracker crews flew two 4½-5-hour flights a day, achieving a 7.8-hr. daily utilization per aircraft—perhaps some indication that the training is successful.

Over cold waters anti-exposure suits are mandatory. Because of their ability to fly lower and make tighter turns, the Trackers are called in after visual contacts are made by the faster, longer-range Neptunes. Helicopters are then sent to "dunk the ball" (sonar), and destroyers are called in to complement the airborne team.

Rear Admiral John S. Thatch, Commander of Anti-submarine Defense Group Alfa, says: "We feel the contact is never really solid until a destroyer arrives with its superior sonar and staying power." ASW submarines, with their superior listening equipment, may be used in case the target submarine breaks contact with the aircraft and destroyers. The work of all units is co-ordinated by a "dip boss," an officer in charge of correlating electronic intelligence.

Admiral Thatch added that one of the biggest strides made tactically was the conversion of skippers who at one time wanted to kill the sub by themselves.

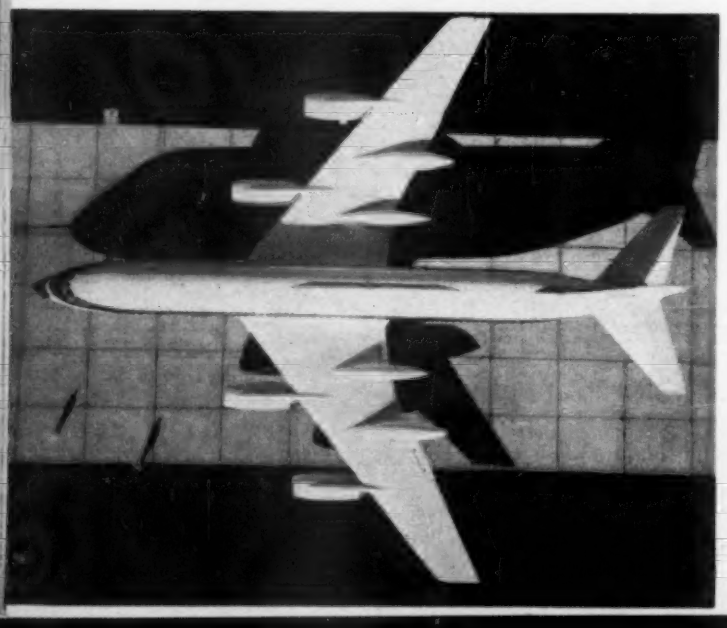
Another kind of teamwork is evident at Grosse Ile, which is guarded by an Army Nike Ajax missile unit. Its three sections (of four launchers and 10 rounds each) can fire at the rate of one missile a minute.—N.A.M.

Speed Capsules and Their Purpose

LONG streamlined bodies on the upper wing surface of the Convair 990 jet transport are one of its most distinctive features. These streamlined shapes extend well behind the trailing edge of the wing. Convair calls them "speed capsules." Why are they used and what are their advantages?

Basically they are intended to decrease the strength of shock-waves on the wing at high subsonic speed and thus to reduce flow separation, allowing the drag-rise speed of the aircraft to be increased. The forward portions of the bodies decelerate the supersonic flow ahead of the shockwave above the wing, reducing the strength of the shockwave and the associated separation. As a result the drag-rise Mach number of an aircraft can be increased, allowing a higher cruising speed.

In the U.S. the use of shock bodies on the wing has sprung from the area-rule work of R. T. Whitcomb. In a 1958 NACA technical note Whitcomb reported the results of a test on a relatively thick 35° swept wing of aspect ratio 7.05. It was mounted on a contoured fuselage. The addition of shock bodies on the upper surface greatly reduced the separation at high subsonic speeds, giving marked drag reductions and improved flow. At a lift coefficient of 0.3, the bodies reduced the drag coefficient by about 0.01 at Mach 0.92; they increased the drag-rise Mach number by 0.05.



The additions also greatly reduced pitch-up at the test lift coefficients and speeds. When wing sweep was increased to 40° the bodies were even more effective in improving drag and pitching-moment characteristics.

But these "speed capsules," or "Whitcomb bumps," do not give something for nothing. They increase the skin-friction drag of an aircraft and add to its weight. In fact, tests for a British V-bomber indicated that they would improve the drag-rise speed by Mach 0.02, but that this was an advantage virtually nullified by an increase in skin-friction drag.

This suggests that designers are unlikely to use shock bodies if they can get the required results in other ways. In the case of the Convair 990 (which was known until recently as the Convair 600), its wing is based on the Convair 880 wing, but the chord has been increased. This has reduced its thickness/chord ratio and, in conjunction with speed capsules, has allowed the cruising speed of the aircraft to be increased.

Flow is supersonic over much of the upper wing surface. Convair anticipate that the aircraft will be authorized to operate at speeds up to Mach 0.91. Maximum cruising speed will be 640 m.p.h., compared with 615 m.p.h. for the Convair 880.

The Convair 990's inboard speed capsules are 21 ft. 6 in. long and the outer ones 24 ft. long; they are 2 ft. in width at their widest point. Fuel is carried in these capsules, which have a flat underside where they project behind the wing, so that they do not interfere with flap operation or under-wing airflow. Inboard capsules each hold about 300 gal. of fuel; outer ones carry about 220 gal. each.

Capsules of this size must add considerably to the weight and drag of the Convair 990; setting out a balance sheet of their advantages and disadvantages must have been an interesting exercise for the design team.

Incidentally, British work of this type by Küchemann goes back for many years. In 1956 a Javelin was flight-tested with streamline bodies on its wing which were known as "Küchemann carrots"; the aim was to extend the buffet boundary. The tests were successful, but similar results were achieved using vortex generators and thickened trailing edges on the ailerons. As these were a lighter and cheaper solution, they were adopted instead of the streamline bodies.—J.R.C.

Background to Dyna-Soar

KENNETH GATLAND *examines the ambitious U.S.A.F. project for a delta-winged hypersonic glider which is intended to orbit the Earth, re-enter the atmosphere, and land at an airfield of the pilot's choosing.*

THE idea of a space-vehicle which could leave the Earth's atmosphere as a ballistic missile and subsequently transform its path into a protracted glide in the upper atmosphere is not new to astronautical thought. Indeed, the first serious design-study was made more than 20 years ago by Dr. Eugene Sänger and Dr. Irene Bredt at Truan. The results of their classic work are recorded in an extensive report, "Uber einen Raketenautrieb für Fernbomber."*

This design envisaged a manned rocket-powered aircraft, boosted for take-off along a 1.8-mile rail track. It would attain hypersonic speed at burn-out and return to Earth along an undulated "skipping" trajectory, transforming at the termination into a flat supersonic glide. By this means it was proposed to achieve ranges of more than 10,000 miles (Ref. 1).

At Peenemünde, too, as early as 1942, attention had begun to turn to the idea of a winged rocket which, mounted on top of a powerful booster, could be launched over great distances with a V-2 type warhead. Dr. Wernher von Braun himself, in an interrogation report obtained after his capture by American forces in 1945, spoke of the possibility of this winged vehicle—the A-9—which he considered might carry a man 3,000 miles to effect a conventional aircraft-type landing. By adding a further, larger, boost rocket (the A-10) to this combination, with improved mass ratio and better propellents, he considered it possible to bring the top component to orbital velocity.

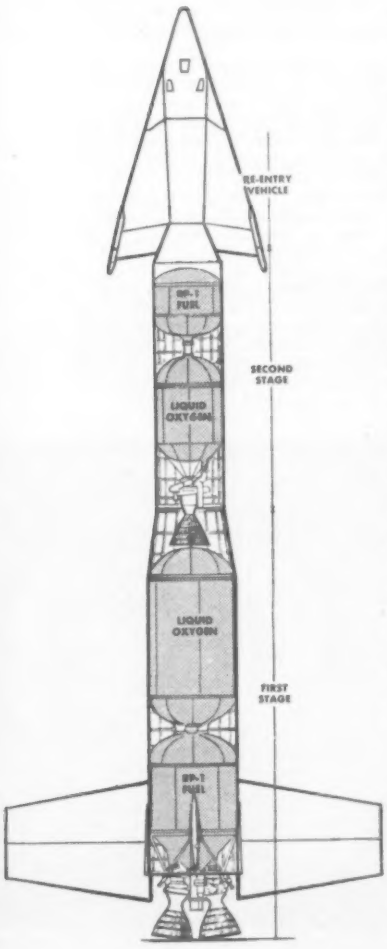


Diagram of the Titan 1 booster with Dyna-Soar mated (not to scale).

After the War several schemes were considered in study projects by Convair and General Electric for development as pilotless glide-weapons. This work, however, was quickly by-passed when high-thrust rocket engines and lightweight rocket structures showed the way to ballistic missiles of outstanding range and performance, and which, moreover, could embody a nuclear warhead of considerably reduced mass.

The great disadvantage of the A-9 boost-glider was that its approach speed "on target" was such that interception was still a feasible proposition. The vehicle was designed to dive onto its target without separation of the warhead.

Thus the idea of the boost-glider was allowed to lapse until it became possible to think in terms of putting a man into space and effecting his recovery. Even then the first manned orbital vehicle officially conceived in the United States was not a winged vehicle but a ballistic capsule, closely akin to the nose-cone of an ICBM. This, of course, has emerged as the celebrated Mercury Project.

In this drawing by a Boeing artist, Dyna-Soar is shown re-entering the atmosphere with leading edges glowing from the heat generated by air friction. The entire vehicle is enveloped by a super-hot plasma which, in practice, may reach a temperature of 20,000 to 25,000°F.

Reasons why the ballistic approach was adopted in preference to lifting re-entry were basically these: First, the available booster did not permit the orbital payload to exceed 1 ton; secondly, the ballistic capsule was considered a relatively short-term development in view of progress with stabilized missile nose-cones and ablative heat-shields; and, thirdly, the boost-glider required a more complex structure for which there was relatively little practical experience even in the laboratory.

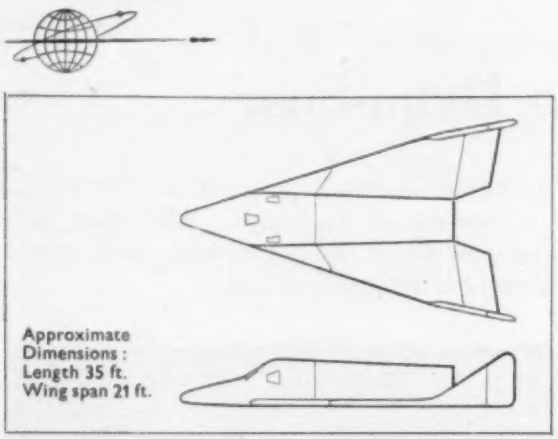
Nevertheless, the idea of the boost glider was kept alive by Bell Aircraft Corporation in the Robo and Bombi projects, and

* A Rocket Drive for Long-range Bombers.

	TITAN I SM-68	TITAN II SM-68B
Length	108 ft.	120 ft.
Body diameter	10 ft. (stage 1) 8 ft. (stage 2)	10 ft. (Stage 1) 10 ft. (stage 2)
Launching weight ..	220,000 lb.	270,000 lb.
Powerplant	2 × 150,000 lb. s.t. Aerojet-General XLR-87 (stage 1) 1 × 80,000 lb. s.t. Aerojet-General XLR-91	2 × 170,000 lb. s.t. Aerojet-General (stage 1) 1 × 85,000 lb. s.t. Aerojet-General
Propellent	LO_2/RP-1 (stages 1 and 2)	N_2O_4/UDMH+H (stages 1 and 2)
Cut-off velocity	17,200 m.p.h.	18,500 m.p.h.
Range	8,000 n. miles	12,000 n. miles

Potential Dyna-Soar boosters.

The above data relates to the two versions of the Martin Titan now under development as ICBMs. Titan I has already been selected by the U.S.A.F. as a sub-orbital launcher for Dyna-Soar tests to begin at Cape Canaveral in 1963. LO_2=liquid oxygen; N_2O_4=nitrogen tetroxide, and UDMH+H=a mixture of unsymmetrical dimethyl hydrazine and hydrazine.

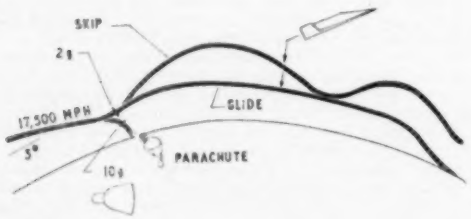


Dyna-Soar provisional drawing.

also at Goodyear Aircraft Corporation with their Meteor studies. Prime-mover in this work at Bell was Dr. Walter Dornberger, formerly in charge at Peenemünde; Mr. Darell C. Romick was in charge of the Goodyear feasibility study involving a delta-winged manned satellite with recoverable booster stages (Ref. 2).

Closely involved in this work, too, were the laboratories of NACA (now NASA), whose efforts have concerned both half-cone shapes and glide vehicles of more conventional form. Technical papers outlining thoughts on these configurations at NACA's Ames Aeronautical Laboratory began to make their appearance in 1957. For example, A. J. Eggers, Jr., pointed out (Ref. 3) that a glide-vehicle developing lift-drag ratios in the neighbourhood of, and greater than, four was far superior to the ballistic vehicle in its ability to convert velocity to range. Although it had the disadvantage of having far more heat convected to it, the vehicle had the compensating advantage that this heat could, in the main, be radiated back into the atmosphere.

Eggers came to the conclusion that the wings of a



NASA diagram illustrating re-entry characteristics of two basic types of orbital vehicle—ballistic, and boost-glide.

hypervelocity glider should have highly swept blunt leading-edges to alleviate the local heating problem. Although blunting the fuselage nose would not necessarily increase the drag of the body, Eggers stressed that blunting the leading-edge of the wing would incur a drag penalty and thereby reduce the lift-drag ratio. But, he continued, this difficulty might be largely circumvented by simply sweeping the wing leading-edge.

The leading-edge drag as a proportion of total drag reduces approximately as the square of the cosine of the angle of sweep for constant span. This, coupled with the fact that the wing-weight should be minimized, suggested the use of a low aspect ratio delta wing with vertical tail surfaces.

It was in 1954 that the U.S.A.F., NACA and the aircraft industry began to study the theory of hypersonic flight in detail, and at an early stage the limitations of conventional wind-tunnels and shock-tubes were appreciated. For the latter experiments the temperature of the gas in the "tunnel" is required to be so great that the gas cannot be contained for more than a few milliseconds.

It was also impossible to conduct such experiments on anything but a small scale. The only practical alternative would be to resort to free-flight experiments, a costly and difficult procedure as the models must be exposed to full-scale flight speeds.

Notwithstanding these difficulties, the U.S.A.F. issued the first preliminary directives on the Dyna-Soar boost glider to industry in November, 1957—a month after the Russians had launched the first artificial satellite into orbit. The specification required the vehicle to combine the high speed of a ballistic missile with the controlled and accurate flight of a manned aircraft. The pilot must have the ability to shorten or lengthen his range by thousands of miles and to manœuvre thousands of miles to port or starboard of his flight path to reach his chosen landing place.

(According to Boeing, it will be possible to select any airfield between Point Barrow, Alaska, and San Diego, California, because of the vehicle's extreme altitude and high speed during the re-entry braking manœuvre.)

By the following March a number of leading American companies had submitted their proposals. From these, in June, 1958, the U.S.A.F. selected two major teams to prepare Phase 1 studies of the project on a competitive basis.

The first team was headed by the Boeing Airplane Company. With Boeing were Aerojet-General Corp.; Chance Vought Aircraft; the Missile and Autonetics Divisions of North American Aviation; Ramo-Wooldridge Corp.; the General Electrical Co., and the Radio Corporation of America. Team two comprised The Martin Company; American Machine and Foundry; Bell Aircraft Co.; Bendix Aviation; Goodyear Aircraft, and the Minneapolis-Honeywell Regulator Co.

As it turned out, both Boeing and Martin were to be involved in the actual development of Dyna-Soar. On Nov. 9, 1959, the U.S.A.F. announced that its Wright Air Development Division, Air Research and Development Command, would become overall manager, acting with the advice and assistance of NASA.

Boeing assumed responsibility for the glide-vehicle itself and, under the direction of the Wright Air Development Division, were asked to integrate the various sub-systems and assemble the vehicle to its booster. They would also be responsible for assembly and testing. The Martin Company were given the task of preparing an adaptation of the two-stage ICBM Titan I for use as a sub-orbital booster.

With U.S.A.F. guidance and subject to Air Force approval, Boeing are selecting major sub-system and component manufacturers on a competitive basis, as they are required in the programme.

Design Features

First step in the development programme is to design and test a glider which will bring a man back to a conventional landing from hypersonic speeds. Lt. Gen. R. C. Wilson, Air Force Deputy Chief of Staff for Development, said at the Air Force Convention in San Francisco on Sept. 22, 1960, that

(*Continued on page 21*)

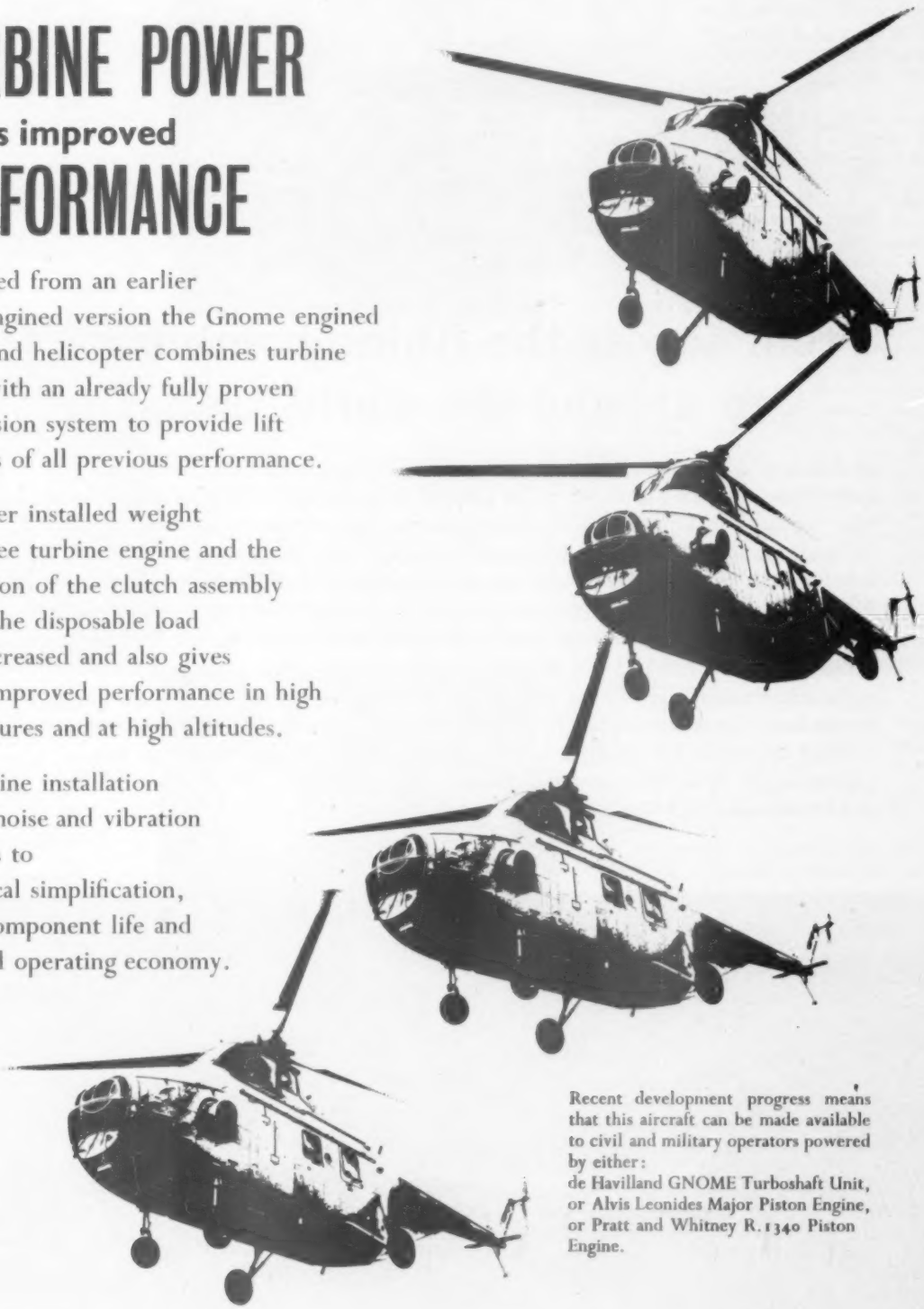
Dyna-Soar "shapes" tested in the hypersonic wind-tunnel at NASA's Langley Research Center in Virginia. Left to right, a basic flow and heat-transfer wing, a basic wing-body combination, and two re-entry vehicles. Model tests in the 11-in. hypersonic wind-tunnel are made in air up to Mach 10 and in helium up to Mach 18.

TURBINE POWER
means improved
PERFORMANCE

Developed from an earlier piston-engined version the Gnome engined Whirlwind helicopter combines turbine power with an already fully proven transmission system to provide lift in excess of all previous performance.

The lower installed weight of the free turbine engine and the elimination of the clutch assembly enables the disposable load to be increased and also gives greatly improved performance in high temperatures and at high altitudes.

The turbine installation reduces noise and vibration and leads to mechanical simplification, longer component life and improved operating economy.



Recent development progress means that this aircraft can be made available to civil and military operators powered by either:
de Havilland GNOME Turboshaft Unit,
or Alvis Leonides Major Piston Engine,
or Pratt and Whitney R.1340 Piston Engine.

WESTLAND *the great name in* **HELICOPTERS**

WESTLAND AIRCRAFT LIMITED · YEOVIL · ENGLAND

Incorporating
SAUNDERS ROE DIVISION, BRISTOL HELICOPTER DIVISION, and FAIREY AVIATION DIVISION

Squadrons of today's Royal Air Force—No. 2 of a series

D.H.9A at Cologne, 1918

From across-the-Rhine bombing to around-the-world transport

99 Squadron has had three lives. It was formed as a strategic bomber squadron of the Royal Flying Corps in August, 1917. The gallantry of the daylight raids into Germany in 1918 was eventually commemorated in the squadron motto 'Quisque tenax'—'Each one tenacious.' Disbanded in 1920, the squadron re-formed in 1924 as a night bomber squadron.

Based in India for most of the war, the squadron, operating with Wellingtons and later with Liberators, carried out many successful attacks on Japanese-held bases. 99 became noted for the accuracy and regularity of its bridge-busting on the Burma-Siam railway.

When the Japanese retreated they left many British prisoners-of-war in Rangoon jail. 99 Squadron successfully dropped supplies into the jail itself—a tricky job which, in a way, foreshadowed the squadron's next role. In 1947 the squadron re-formed at Lyneham, this time as a long range transport squadron. And in 1959, 99 Squadron took delivery of the first military version of the Britannia which carried a payload of over 15 tons.

99's first aircraft—the D.H.9—carried one 230 lb. bomb.

Britannia over Kilimanjaro, 1960

36-year-old Wing Commander W. E. F. Gray, *educated at Ottery St. Mary Grammar School, joined the R.A.F. in 1942. After training in Saskatchewan under the Empire Training Scheme he became an instructor on Ansons; after this his instructing duties ranged from Tiger Moths to Lancasters. 1948 saw his first experience of a Transport Command squadron—with 216 in the Middle East. In 1952 he spent a year as Squadron Leader (Training) at the Central Flying School. Then followed a 3-year tour in the Directorate of Flying Training and two years on Transport Command Examining Unit. He became a Flight Commander in 99 Squadron in 1958 and took over command of the Squadron in October, 1959. He has logged 200,000 miles in the Britannia to date. His comment on the aircraft is to the point,—'No vices'. He is married and, when he finds the time, likes to go fishing or rough-shooting.*

27-year-old Flight Lieutenant Keith Shorrock *has been navigating on world routes since he was 20 and has logged well over 400,000 miles. Educated at King George V School, Southport, he joined the R.A.F. in 1951. After training he joined 84 Squadron in Fayid, Egypt, and was on detachment to Cyprus in 1956. Did a round-the-world trip in 1958 via Australia, Christmas Island and U.S.A. Has also flown to Barcelona, Nairobi, Gold Coast, Canada, Fiji, Honolulu. Looking forward to flying on the Singapore-Hong Kong run. Single, he lives on the station at Lyneham where he runs the sailing club. (He sails a Firefly dinghy and recently crewed in the R.A.F. sailing championships). Likes fell-walking in the Lake District.*

26-year-old Flight Lieutenant Dave Ray *never had any doubts about the career he wanted. Starting in the A.T.C. at 16, he joined the R.A.F. in 1951 as soon as he was 17½. After advanced flying training he went on to Vampires and joined 16 Squadron in Germany. Then, in 1957, he converted to Canberras and joined 69 Squadron which moved to Malta in 1958. Came to 99 Squadron in 1959 as a Britannia co-pilot and has already logged over 90,000 miles. Thinks the Britannia is 'beautiful to fly' but also likes to keep his hand in at gliding at the R.A.F. club nearby. He expects to be an aircraft captain within a year and hopes to be posted abroad. His wife is keen to go, too; no comment from his 1-year-old daughter.*

37-year-old Squadron Leader E. H. Burgess—*always called Pat, despite his initials, because he was born on St. Patrick's Day—is the doyen of the squadron's navigators. Joined the R.A.F. in 1942, commissioned in 1943 with 78 Squadron, Bomber Command, and awarded the D.F.C. after 32 Halifax raids over Germany. Joined 96 Squadron in 1945 on supply-dropping to the 14th Army. The offer of a permanent commission in 1946 changed his mind about becoming a science master. Promoted to Squadron Leader in 1954 while in the Middle East with 78 Squadron again. Joined 99 Squadron, after a period at Staff College, in 1958. His scientific background came in useful in helping to devise techniques for using Britannias economically. He recently flew to Cape Verde Islands; he recommends the local wine which is cheaper than beer. Keeps fit with Scottish dancing and keen, inaccurate tennis. Married, with two daughters.*

The R.A.F. still needs men like these

The Britannias of 99 Squadron don't waste any time. When they take off they go up at an angle of climb that means business. The business is long range support of our overseas forces. This covers a huge range of activities.

To begin with there are the flights in support of the V-bomber force which have earned Transport Command the description of 'the other half of the deterrent'. Again, the Squadron could be called on 'fire brigade' duty, that is to transport fully equipped troops to a danger spot. Then there are the 'milk runs'—the routine flights carrying passengers and freight to stations extending around the globe. Finally there are special runs—flying out urgently needed equipment, or perhaps on aero-medical evacuation (there are plug-in points for iron lungs from the Britannia's own electrical system).

Maintaining 'the other half of the deterrent' obviously calls for men who can take responsibility. It is no exaggeration to say that the captain of a Britannia has one of the most responsible jobs in the world. His own particular skill must be beyond question and he must also be able to get the best out of his crew. He is solely responsible for the safety of his passengers and his freight, not to mention a £1½ million aircraft. He must be familiar with world routes—weather conditions, the characteristics of different airfields, maintenance facilities. He has to be aware of political conditions in the countries he flies over or to, and must sometimes have the gloved touch of the diplomat. Airman, leader, technician, the captain is all these, and he certainly earns his very good pay.

During the next five years Transport Command will double its operations and the demand for aircrew will increase in proportion. Pilots are now being accepted for training direct from R.A.F. Flying Schools and these men have every chance of becoming captains of their own aircraft within four years.

There are plenty of opportunities for you in today's R.A.F.—and you can join when you are 17½.

TODAY'S TOP JOB IS THE R.A.F.

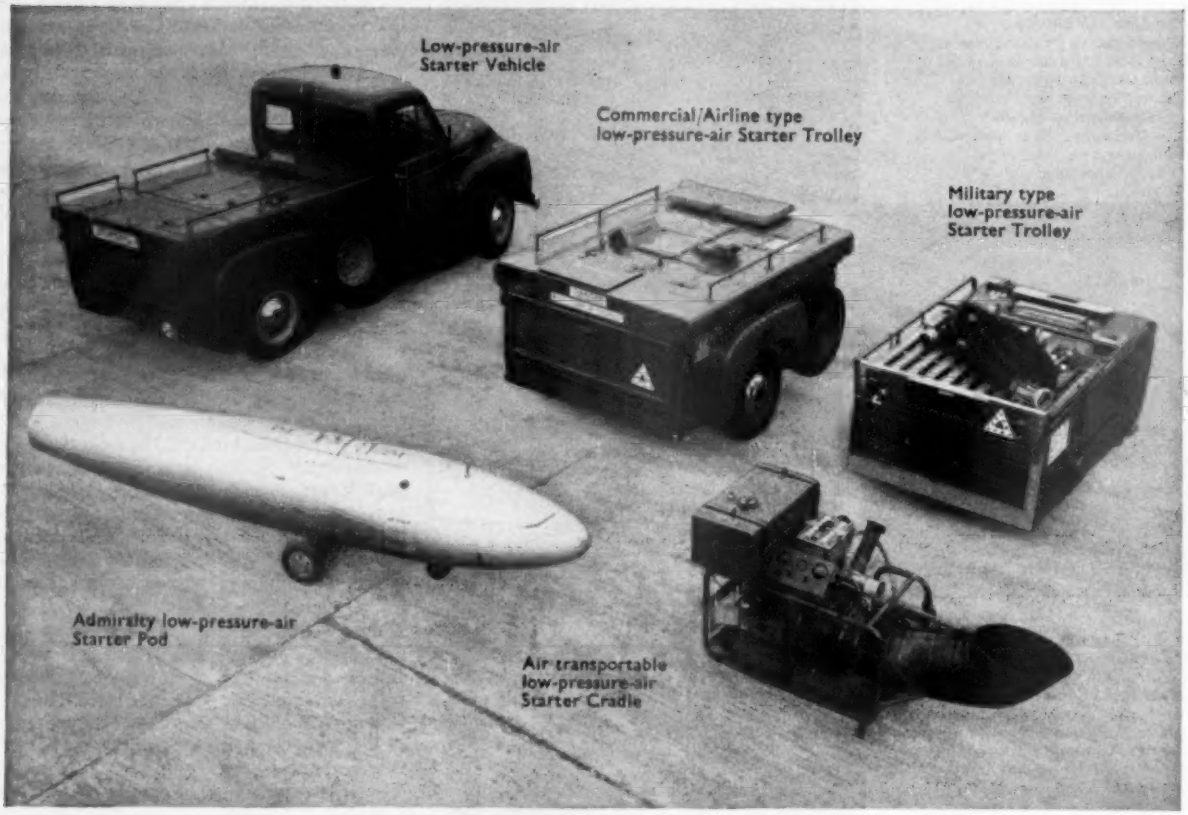
The Royal Air Force

With a flying commission you are guaranteed service to at least 38, and this may be extended to the age of 55. Pay, pensions and gratuities are generous: at 21, as a Flying Officer, you would earn £950 a year; at 25, as a Flight Lieutenant on full allowances, you could be earning over £1,750 a year.

Find out more about flying careers by writing, giving your date of birth and educational qualifications, to: Group Captain J. N. Ogle, A.F.C., A.F.M., Air Ministry (AP 143a) Adastral House, London, W.C.1.

You will be sent full details of the latest pay and career structure, together with an illustrated booklet. This contains the addresses of the R.A.F. Careers Information Centres where you can call in if you would like to talk things over.

To meet all gas-turbine starting requirements


Low-pressure-air Starter Vehicle
Commercial/Airline type low-pressure-air Starter Trolley
Military type low-pressure-air Starter Trolley
Admiralty low-pressure-air Starter Pod
Air transportable low-pressure-air Starter Cradle

Blackburn low-pressure-air engine starting units are in constant use by:

Aeroplane & Armament Experimental Establishment, Boscombe Down
A. V. Roe & Co. Ltd.
Bristol Siddeley Engines Ltd.
Department of [illegible]
[illegible]
[illegible] Page Ltd.
D. Napier & Son Ltd.
National Research Council, Canada
Orenda Engines Ltd., Canada
Rolls-Royce Ltd.
[illegible] Establishment, Bedford
Royal Air Force
Royal Navy
The de Havilland Aircraft Co. Ltd.
The Fairey Aviation Co. Ltd.
Vickers-Armstrongs (Aircraft) Ltd.

OVER 300 IN OPERATION

Blackburn
(LICENSEES FOR TURBOMECA ENGINES)

LOW-PRESSURE-AIR STARTING EQUIPMENT FOR OPERATORS OF MODERN AIRCRAFT

BLACKBURN ENGINES LIMITED, 43 BERKELEY SQUARE, LONDON W.1
Telephone: GROsvenor 5771

Member Company of the Hawker Siddeley Group

E165/a

(*Continued from page 20*)

the first experimental flights of the Dyna-Soar glide-vehicle would be made within three years.

He also reaffirmed that later research and development versions were planned to establish Dyna-Soar as a temporary Earth-satellite. A number of launchings from Cape Canaveral down the Atlantic Missile Range will be involved in establishing the feasibility for manned flights.

Martin said that the Titan booster used in initial full-scale tests would be a proven ICBM model with modifications, including tail fins, increased structural rigidity to accommodate the glider and "the booster portion of the unique protective system for the pilot in case of emergency." This latter device is believed to consist of a manifold of escape rockets designed to push the glider clear of the booster's top stage in the event of a launching failure; it is seen attached to the back of the separated Dyna-Soar in one of the Boeing artist's impressions.

The configuration of Dyna-Soar itself has emerged as something of a marriage between the original ideas of Sänger and the blunt delta shape proposed by the Ames research scientists. In the provisional design released by the U.S. Defense Department, the vehicle has a rectangular-section fuselage which merges with the flat underside of the delta-wing. At the back of the wings are elevons which, in conjunction with twin rudders on the wing-tip stabilizers, serve for control in the lower atmosphere.

It also appears to follow rather closely design features evolved by Dr. Walter Dornberger and the Bell Aircraft Corporation in the boost-glide weapon system (Robo). That, in fact, was the original springboard for the Dyna-Soar project.

Development Problems

The design of Dyna-Soar is deceptively simple. Nevertheless, the aeroplane must operate over a vast range of velocities—from a maximum of about Mach 25 to a subsonic minimum making possible a controlled landing at a conventional airfield. After surviving re-entry conditions, the vehicle must be capable of being re-launched with the minimum amount of replacement parts. As a result of frictional heating, its skin surfaces may look like the insides of a much-used household cooker, but Boeing consider it will be "no major project to prepare the glider for re-launching."

The most severe problem which the Dyna-Soar designers have to face is, of course, related to the aerodynamic and heat loading to which the vehicle will be subjected during re-entry into the Earth's atmosphere. For this reason, much attention has been given to the particular re-entry path which the glider will adopt.

Operating the vehicle with a low lift coefficient, producing minimum drag, will result in a relatively long range. However, an excessive period of time will be spent in the region of maximum heating.

If, on the other hand, the glider begins its re-entry at a high angle of incidence, it will create more drag and descend more rapidly. In each case the glider will encounter the region of maximum heating at speeds of between 12,000 and 15,000 m.p.h.

Here it may be of interest to compare the descent of the boost-glider with that of the Mercury space-capsule, which essentially is little more than an inhabited ballistic nose-cone. Although initially its speed is comparable with the glider, the Mercury capsule will descend more rapidly along a ballistic trajectory and its occupant will experience decelerations of the order of 8-10*g*.

As in the case of ballistic nose-cones, the capsule will be protected from the worst effects of frictional heating by a shield of ablating material. Some 99% of the heat generated is absorbed by the atmosphere and only about 1% flows into the vehicle.

The hypersonic glider can adopt one of two re-entry procedures. If the vehicle remains in the same attitude and the pilot does not exercise any control, the glider will "bounce" out of the atmosphere and back again, following an undulating trajectory such as a flat stone will follow if skipped across the still waters of a pond. At each point of penetration a region of high heating will occur.

The alternative is to control the glider in such a way that aerodynamic lift is used to supplement centrifugal force and counter the effect of *g* on the vehicle. The glider can then be made to follow a flat glide without skipping.

During the few minutes in which re-entry occurs the energy due to the glider's velocity will amount to some 140 million B.T.U.s, and if this large amount of heat were to be absorbed by the vehicle it would quickly vaporize. However, in passing through the atmosphere the glider heats the air as well as becoming heated itself and only a small part of the heat generated actually flows into the vehicle.

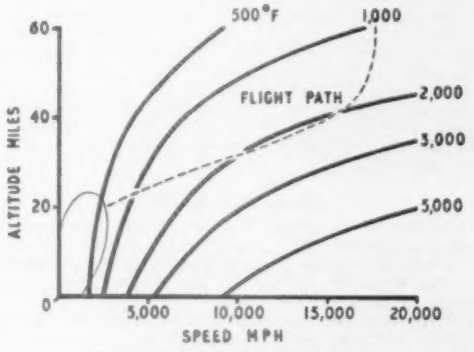
What actually happens at this stage is shown graphically in an accompanying artist's impression. Instead of flowing smoothly around the glider, the air packs up in front of the fuselage nose and the wing and stabilizer leading-edges. The hot-air plasma that develops as the air moves to get out of the way of the fast-moving vehicle will deal severely with any fin or rough edge which projects into the airflow. If the vehicle's bluntness is increased, and it is given a flat re-entry path, more heat can be transferred to the atmosphere.

Radiating Structures

Winged vehicles, of course, have a much greater surface area than ballistic re-entry bodies and they are less blunt. In this case heat loads become excessive and cannot be absorbed in the structure. One possible solution is to provide the vehicle with a radiating skin, but to do this effectively it must be allowed to get very hot—about 2,000° C.; this involves the most severe metallurgical/fabrication problems.

The areas of maximum heating in the case of Dyna-Soar will be at the fuselage nose, the wing leading-edges and the leading-edges of the vertical stabilizers. At these points it will not be possible to utilize the high-temperature "super-alloys" and it is necessary to resort to ablating materials or materials such as ceramics and graphite.

Relatively cooler parts—those only red hot—can be made in the form of a radiating structure. This has been the subject



Temperatures for hypersonic flight.

of much experimental development within NACA (and NASA) laboratories.

A typical structure of this kind makes use of corrugated metal to permit the maximum amount of expansion under high heating to prevent buckling. These accordion-type movements in the structure are supplemented by sliding movements between the skin panels by means of expansion joints.

Tests made with the aid of powerful radiant heaters have shown the possibility of these structures retaining adequate stiffness and strength to survive the re-entry braking manœuvre. The big problem, however, is to find materials of sufficient quality—and quantity—for use at these elevated temperatures. Much attention has, therefore, been given to testing sample materials under rigorous heating conditions and making them suitable as structural components.

High-temperature materials of interest are molybdenum, columbium, tantalum and tungsten. One of the most promising alloys is molybdenum, but this has the disadvantage that it oxidizes very rapidly at high temperatures unless the surface is adequately sealed.

One of the most promising coating materials, known commercially as W-2, has been shown by NASA to have a useful life of between 10 and 100 hours when exposed to temperatures of 2,000° to 3,000° F. The coated test-sample was a 2.5-in. square of molybdenum sandwich construction with a corrugated core. Structures made in this way have achieved lifetimes of two to three hours.

A disconcerting aspect of the oxidation problem became apparent early in the research programme. After a short time of exposure to high temperatures small areas of the skin showed evidence of attack by oxidation which, at first, did not seem too damaging. When the W-2 coating was removed, however, the molybdenum skin was found to be full of holes. Inspection led to the conclusion that these had resulted from minute pinholes or cracks in the protective coating which had allowed oxygen molecules to leak through to the metal.

At a recent meeting of the Pacific Northwest Section of the American Rocket Society, Mr. George H. Stoner, programme manager of the Dyna-Soar project, drew attention to some of

these metallurgical problems. The high-temperature alloys have not previously been made in the quantities or shapes required for aircraft application, he said, so that Boeing engineers must learn how to make rivets, screws, bolts and thin sheets in these super-alloys.

Problems of welding, cutting and forming tough and sometimes brittle alloy materials are particularly great. Shot-tubes have been built to obtain data at the high end of the speed range, while wind-tunnel research is being made into the vehicle's characteristics at lower speeds. From the results of this test programme, it is expected to make subtle changes in the shape of the glider—and its control surfaces—in an effort to improve the overall characteristics.

However, even the simplest change of a radius or an angle on the design must be rechecked in a large number of wind-tunnels over the entire speed range to determine if the net result is beneficial. And, for each wind-tunnel test, a complicated model with instruments for making the required measurements must be constructed.

Ancillary Services

There are other fields of similar complication which must be carefully investigated before Dyna-Soar can be expected to fly safely. Examples are the air conditioning equipment inside a red-hot aeroplane, its auxiliary powerplant to furnish electrical and hydraulic power for the controls and equipment, and radio systems to enable the pilot to maintain contact with ground stations when the glider is immersed in a hot ionized plasma under re-entry conditions.

Reports suggest that Dyna-Soar will have an electrical generator powered by an H_2/O_2 turbine. Some of the stored hydrogen will be bled off to cool the cockpit and the electronics, while the turbine exhaust products are used for the glider's attitude control.

Model Experiments

A vital part of the preliminary test programme will involve launching Dyna-Soar scale models from Cape Canaveral. A series of nine launchings is planned using the HETS-609A Blue Scout, the U.S.A.F. variant of the Chance Vought Scout four-stage, solid-propellent, rocket.

For these tests, two aerodynamic scale models of the hypersonic glider are being prepared under U.S.A.F. contract by the Flight Sciences Laboratory, of Buffalo, N.Y., and three scale models embodying sample Dyna-Soar materials by the McDonnel Aircraft Corporation. First of these test launchings is expected within the next few months.

First task in the full-scale development programme will be to build a glider capable of being drop-launched from a B-52 mother aircraft. It is possible that this stage will be reached by 1962. This will permit study of stability and control at low speeds; later in the programme, provision of a small rocket motor may extend these investigations to include low supersonic speeds.

Next, probably in 1963, will come the first unmanned sub-orbital launchings from Cape Canaveral using the modified Titan booster under radio-inertial guidance. This will amount to a demonstration of the structural integrity of the boost-glider combination and an evaluation of the emergency escape system. Also, it will permit checks to be made of the aerodynamic stability and performance at higher supersonic speeds, separation of the boost stages, and separation of the glider with increasing cut-off velocity of the booster. When this phase is satisfactorily concluded, a glider which embodies the accumulated test experience of previous vehicles will be given a human pilot for the purpose of monitoring further test operations and taking overriding control.

Initial landings are expected to be made at or near a down-range island, possibly Ascension, with the U.S.A.F. Flight Test Center, Edwards Air Force Base, in California, the destination for later near-global range and orbital flights. These latter missions have been stated to involve a larger booster. Raytheon have been studying equipment for a Dyna-Soar recovery control centre to be established at Edwards by 1963-64.

Present plans envisage a test programme requiring 18 vehicles, seven unmanned and 11 manned. Total cost would be about $495 million.

Operational Missions

Although Dyna-Soar is still in an early stage of research and development, the U.S.A.F. already see in it the beginnings of a manned, orbital, weapons system. Apart from pioneering a new mode of high-speed transportation and providing the incentive for the development of radically new aircraft materials, they emphasize that it will permit entirely new concepts to be evolved in military operations.

In combining the high speed of a ballistic missile with "the controlled and accurate flight of a manned aircraft," the Dyna-Soar glider will differ from all other space vehicles in its ability to make a controlled re-entry into the Earth's atmosphere "at a chosen time with the necessary manœuvrability required for selective, controlled, touchdown at a conventional airfield."

These, at least, are the objectives. If they are realized, it may be possible to develop operational variants of the test-vehicles for many purposes, including: (1) Long-range selective reconnaissance. (2) Bombing of point targets following re-entry from orbit, release of the "warhead" taking place at hypersonic speed along the glide-path.† (3) Orbital inspection and/or destruction of unidentified or "hostile" satellites. (4) Space-rescue operations. (5) Ferry missions between Earth and space stations (transfer of men and provisions, etc.).

All this presupposes the use of boost-gliders on a large scale, which focuses attention on the need for economy in the boost phase. A previous article (Ref. 4) examined the possibility of adapting the forthcoming B-70 Valkyrie supersonic bomber as a first-stage booster; an official report showed that the aircraft should be capable of launching payloads of up to 15,000 lb. at a speed of 2,000 m.p.h. at an altitude of some 70,000 ft.

On the assumption that the 550,000-lb. supersonic aircraft can carry a maximum payload which exceeds 10% of the all-up weight, it should be possible for the B-70 to launch a 10,000-lb. spacecraft plus a 40,000-lb. high-energy booster. It will be interesting to see if this type of combination can be effectively developed to permit the launching of global-range boost gliders.

† As, indeed, was suggested by Sänger and Bredt in their antipodal bomber project (Ref. 1).

References

(1) Gatland, K. W., "First Steps to Boost-Gliding," THE AEROPLANE AND ASTRONAUTICS, Apr. 8, 1960, pp. 436-8.

(2) Romick, D. C., Knight, R. E., Black, S., "Meteor Junior" (a preliminary design investigation of a minimum-sized ferry rocket vehicle of the Meteor concept), Goodyear Aircraft Corp., presented at the 8th I.A.F. Congress, Barcelona, Oct., 1957.

(3) Eggers, Jr., A. J., "Performance of Long Range Hypervelocity Vehicles," *Jet Propulsion*, Nov., 1957.

(4) Gatland, K. W., "Towards a Recoverable Space Booster," THE AEROPLANE AND ASTRONAUTICS, Nov. 25, 1960, p. 719.

Full-scale section of a proposed hypersonic glider under study at NASA's Langley Research Center. Test structure, made of Inconel-X, a high-temperature nickel-base alloy, is subjected to intense heating by quartz lamps as a means of investigating deformations of parts of the structure and for measuring the internal temperature.

Personal Flying

FROM Air Cdre. H. Probyn, R.A.F. (Retd.), now living in Nyeri, Kenya, comes the following account of the conversion of a Grunau Baby glider to power, with the aid of a Volkswagen car engine.

It has flown 40 hours, is easy to fly and is very economical. The aircraft was constructed by the Air Commodore at Nyeri, Kenya, with the help of a Kikuyu carpenter and a labourer.

It is a pusher with the engine mounted on a triangulated steel tube frame above the wings, the feet welded to mild-steel plates connected to the wings and fuselage through the standard fittings.

The drive is direct via a fabric flexible coupling through a 2-in.-dia. shaft. Parts of the rear of the wings and the streamlined hump on the fuselage were cut away to permit the propeller to revolve.

The main skid has been removed and a springless steel tube undercarriage connected to No. 4 frame shoulder and the bottom fitting holding the main wing struts. The wheels are 14-in. by 3-in. commercial pneumatic. The axle runs above and across the bottom false skid. The ground clearance is 4 in. A steel tail skid is fitted.

The engine is a standard car Volkswagen. The generator, fan, starter motor and cooling cowling have been discarded and the carburetter manifold cut down. Accumulators originally provided the ignition but a magneto was being fitted to the distributor drive when the Air Commodore wrote.

A standard Turbulent Ardem propeller is fitted and gives approximately 3,000 revs. at 6,000 ft. The complete aircraft weighs about 530 lb. empty.

Take-off at 6,000 ft. is under 300 yards, no wind; ceiling 11,500 ft., no thermals; cruising at 8,000 ft., 60 m.p.h. No wheel brakes are fitted. Despite the high thrust line there is very little alteration of trim with engine on or off. Taxi-ing is difficult in a high wind. Some icing of carburetter has been experienced but has been overcome.

The aircraft has excellent visibility and with its good climb and slow flying capabilities is an excellent platform for viewing game.

SIMPLICATION.—The extremely practical installation of the Volkswagen powerplant on its welded steel tubular mounting.

Air Cdre. Probyn had originally flown this glider for some years but had found it a most strenuous performer at the local altitude of 6,000-8,000 ft. To get airborne on a narrow runway with very variable and often light winds entailed a good deal of effort and ancillary apparatus. To retrieve the glider along the local bad roads and tracks, with telephones few and far between, was arduous, and also wasted a good deal of time.

"Now," as he writes, "thank goodness, I have dispensed with all the complications of a high-powered car, trailer, cables, winch, crew, etc. I still use thermals to gain height and can soar with the throttle closed.

"Of course the two methods of flying, pure soaring and power assistance, are poles apart, but as all the paraphernalia is done away with one is able to get a lot of flying fun in one's late years without strain and very much less expensively."

Gliding Notes

by Dr. A. E. Slater

IT now appears that the 1962 World Championships may be held in the United States. There was some argument at the latest F.A.I. Gliding Commission meeting on the best site: should it be the traditional soaring centre at Elmira, N.Y., where the climate and landscape are European in type, or in the magnificent but uncomfortably hot soaring terrain of Texas? Bishop, Calif., is another possible choice, but it is a long way off, and its famous waves rarely operate in summer.

* * *

CAMBRIDGE UNIVERSITY GLIDING CLUB announces that, during the past academic year, Siegfrid Neumann has climbed farthest up the "president's ladder" with a total of 1,675 points. John Pringle, after whom the ladder is named, scored 746, Lionel Alexander 539 and Peter Neilson 506, while P. W. James, as the best undergraduate with 446 points, gains a trophy and prize. The scoring system is highly mathematical.

R.A.F. apprentices at Halton have started a gliding club, with Flt. Lt. B. B. Sharman as chief instructor.

Another club newly affiliated to the British Gliding Association is the West Wales Gliding Association. It already has a T-21 two-seater and operates on Haverford West aerodrome, with T. Gil Phillips as chief instructor. Two Easters ago (or was it three?) Gil Phillips organized a short gliding course there to test local interest.

* * *

FROM Canterbury Gliding Club a new duration record for New Zealand, 9 hr. 1 min., has been set up by S. H. Georgeson.

Winner of the decentralized National Contest in Germany for 1960 is Rolf Kunz, it is announced by *Der Flieger*. Kunz came 16th out of 37 entrants in the Open Class in the World Championships of 1958, when he flew the HKS-1.

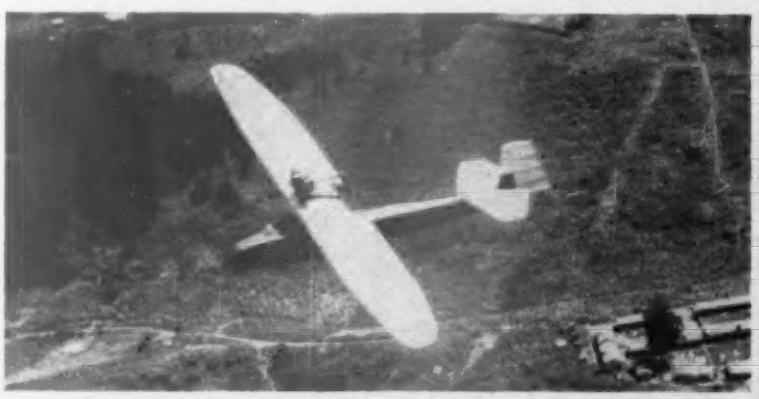
* * *

TWO Sydney firms have been granted the Australian agency for importing sailplanes, one from Poland and the other from Czechoslovakia, and early this year there will be a Bocian two-seater and a Mucha 100 single-seater from Poland, and a Blanik from Czechoslovakia, touring Australia giving demonstrations.

The Slingsby Gull 1, imported into Australia in 1938, is still being flown in West Australia by its present owner, Ran Macdonald. He reached 7,100 ft. in it last April, *Australian Gliding* says, but last May it was lifted off the ground by a dust devil, and is only now repaired.

Another West Australia pilot, Frank Hawkes, went 171 miles in a Fauvel AV-36 flying wing on his first cross-country flight, taking 5½ hours and reaching 10,000 ft.

Youngest solo pilot in the Walkerie Gliding Club, South Australia, is Ken Hartley, aged 14, who has already done 33 hours in a Grunau during four months. Ron Brock, now aged 15, has been flying solo since he was 11, and Elspeth Barratt, aged 16, is believed to be the youngest girl glider pilot in Australia. At another club Roger Farquhar is flying solo at 15.



FLEXIBLE CONVERSION.—Air Cdre. Probyn's home-built Grunau with Volkswagen engine flying over Nyeri in Kenya. An earlier picture appeared in our issue of Jne. 10, last.

Industry Record

Chloride Changes

To achieve closer liaison between their technical, production and sales departments, Chloride Batteries, Ltd., were to transfer the major portion of their sales headquarters from London to the head office and principal manufacturing centre of the company at Exide Works, Clifton Junction, near Manchester, on Jan. 2, 1961. A London sales office will be maintained at the present address (Grosvenor Gardens House) until Jan. 31, when it will be transferred to 137 Victoria Street, London, S.W.1.

Mr. A. C. Stewart, the present sales manager, who is approaching retirement age, will not be moving north. He will be succeeded by Mr. M. A. Griffith-Jones on completion of the move but his services will be retained by the company in the capacity of consultant until he retires.

Aviation Developments

Recent commercial marketing of the Aviation Developments, Ltd., range of industrial fasteners, Huckbolts, Jo-Bolts, Chobert and Avdel rivets, Avlok blind bolting and so on has necessitated the construction of new office accommodation and factory premises. These are now well under way on the Welwyn Garden City industrial site.

This new factory which will provide approximately 95,000 sq. ft. of floor space is scheduled to be ready for occupation in April, 1961. It will be replacing the scattered offices and factory into which the company has grown since it started business in 1936.

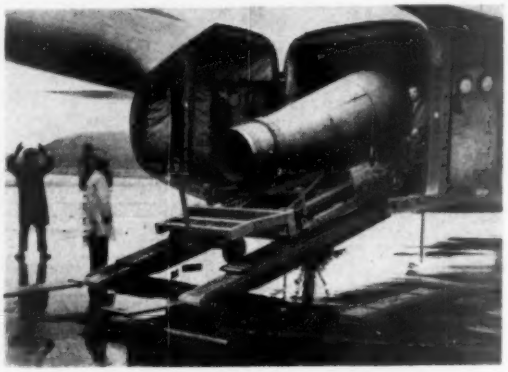
Herald Automatic Approach

The Sperry Flight Director Gyropilot has been chosen for the Handley Page Heralds, six of which were ordered recently for Jersey Airlines, three by B.E.A.

This unit couples the Sperry lightweight A.L.30 Gyropilot and the company's Zero Reader flight director to bring large aircraft instrumentation and control standards to the branch-liner category, without complexity or significant weight increase. The combined equipment, in fact, gives an additional installed weight of 30 lb.

These orders are the follow-up of the trouble-free performance of the A.L.30 Gyropilot and Zero Reader flight director equipment installed in the second prototype Herald and first production aircraft which in four extensive sales demonstrations—to India, South America, Australasia and West Africa—flew some 750 hr., visiting 180 different airfields. No Sperry spares were carried or needed on these demonstrations apart from a routine filter element change.

Other new A.L.30 orders include those for the Piaggio 166, and the Fokker Friendship for which the equipment is part of the manufacturer's standard specification.



An Industrial Acoustics trailer-mounted noise suppressor for the Royal Norwegian Air Force being loaded aboard a C-119 at R.A.F. Northolt for air-lifting to Stavanger. Fitted with hydraulic jacks, the suppressor can be lifted and angled for use with RF-84s, F-86Fs, or T-33s and weighs approximately 2 tons.

VC10 Intercom

Ultra Electronics, Ltd., are to supply communication control and cabin address installations for the 35 Vickers VC10s ordered by B.O.A.C.

Value of the contract is approximately £100,000 and the equipment to be supplied is the new Ultra UA 60 push-button communication control system, cabin address amplifiers type UA 6000 and cockpit address system type UA 6006. The UA 60 intercom system is fully transistorized and has also been specified for the Short Britannic, the D.H. Beaver, the Westland Sprite, the Avro 748 for Skyways and B.K.S., the Handley Page Herald and the Westland Wessex.

Arc-welding Generator

A new generator designed to withstand the inherent vibration of diesel engine drives has been introduced by Petbow, Ltd., for use with their range of arc-welding sets. The main case is fabricated from mild steel in the form of two welded barrels which are spigoted and bolted together and the field coils are detachable without removing the armature or dismantling the complete case. The armature shaft is of high grade steel and the armature core pack is built up of low-loss, high-permeability iron laminations, as are the field poles and interpoles.

Cooling is by a specially designed centrifugal fan which draws air from the drive-end past the commutator and field coils. This system keeps the temperature rise to a minimum even in very high ambient temperatures.

Two handwheels are provided for controlling the welding current and voltage to suit the type of work and electrode. A total of six welding ranges can be selected and approximately 8kW at 65V DC is available for the operation of hand tools when the unit is not required for welding.

Stabilized Power Supply

W. G. Pye and Co., Ltd., are now producing a stabilized power supply unit for general experimental work in the laboratory. It is stated that the design has been thoroughly tested and stability on all types of load, particularly capacitive loads, is ensured.

The unit, which requires an input of 110-120V or 190-250V, 40-60 c/s, has both DC and AC outputs. These include DC outputs from 0 to 500V, a fixed negative supply of −250V and a variable negative supply of 0 to −250V. Two AC supplies each of 6.3V at 5A are also provided.

New Radio Equipment

Military attachés from 17 countries, as well as NATO and Ministry representatives, attended a cocktail party given by the Plessey Co., Ltd., at the Hyde Park Hotel on Dec. 13, to introduce and display a new VHF mobile military radio transmitter/receiver.

Known as the C-42 Mark 2, the new equipment has been designed to meet increased demands for frequencies in the VHF communications band and has been developed for the Ministry of Aviation. Evaluation of the unit is now being undertaken by the Signals Research and Development Establishment, Christchurch, in conjunction with the Plessey Telecommunications Division, and will be followed by Service trials.

English Electric-Sundstrand constant speed drives are manufactured on these production lines at Netherton, near Liverpool. The drives form part of the constant frequency power supply system which has been developed by the company's Aircraft Equipment Division at Bradford.

Correspondence

Justifying a Drastic Remedy

BY regretting that fuel technologists have not "answered" Lord Brabazon's claims made during a recent "Panorama" programme, Mr. Colbourne (Dec. 9, last) seems to imply that his Lordship's arguments are invalid. Will it make your correspondent feel any better if I point out that there was a fuel technologist present at our demonstration? I shall be glad to effect an introduction if so desired.

Mr. Colbourne should also know that other fuel technologists, and very eminent ones, have over the years made identical claims to those of Lord Brabazon.

I, too, am unhappy that we should have used television to remind the public of the fire hazard associated with air travel. But a desperate situation requires a drastic remedy: can Mr. Colbourne suggest a more effective means of trying to stop airlines using JP-4 fuel?

Harpenden, Herts. J. W. RICKARD.

The First Unbraced Monoplane

"CANTILEVER STORY," by Air Cdre. H. V. Rowley, A.F.R.Ae.S. (THE AEROPLANE AND ASTRONAUTICS, Dec. 23, 1960) was, to my mind, as good a Christmas present as anyone could wish for. Naturally this provoking article leads me to inquire whether the Levavasseur Antoinette was indeed the first cantilever aeroplane ever to be built? Also was the Antoinette engine (which I find described in another very old aviation book as steam-cooled) the first to use direct injection? The Spats had no rival but even that may be questionable.

Finally, although astronautics has its appeal to those who look ahead, I am glad to see that THE AEROPLANE is not neglecting the historical side.

Billesley, Birmingham, 14. MAURICE AUSTIN.

An Alternative to Facing Backwards

WITH reference to the letter from Sir Vernon Brown "Backward Facing Seats," THE AEROPLANE AND ASTRONAUTICS, Oct. 21, 1960, the thought has occurred to me that the apparent lack of interest may be due to the psychological effect of reversing the seats. I would, therefore, like to suggest a compromise.

If a suitable plastic air bag were fixed to the back of the seat, in front of the passenger, and inflated in an emergency to a pressure of ½ lb./sq. in. it could be made to support a person even at 20*g* deceleration, in much the same way as the rearward-facing seat. It could possibly be added with little modification and small cost. It would, of course, require to be partially shaped, its largest section being in the region of the upper part of the body.

Tethorpe, Norwich. A. H. W. DORMER.

Our Unhonoured Pioneer

I WISH to congratulate you most warmly upon the editorial entitled "A Pioneer to Honour," in the Dec. 2 issue.

By an extraordinary coincidence, I had just finished reading, for the third time, a copy of a manuscript entitled "Stressed-skin Metal Construction," by Hugh Oswald Short, Hon. F.R.Ae.S. Mr. Short had kindly sent me a full copy of this, which has never been published, soon after I launched the campaign to preserve a Short Sunderland a year ago. This campaign is now in its successful closing stages.

Immediately I put this manuscript down I opened THE AEROPLANE AND ASTRONAUTICS, and was surprised and gratified to see that you had taken the initiative in drawing attention to what must be one of the greatest examples of unrewarded service to the country, for many years.

As an interested but uncommitted enthusiast and student of British aviation in general, it has for many years been a source of wonder to me that, in the long and distinguished list of pioneers and leaders of industry, the name of Hugh Oswald Short has still not been rewarded with the knighthood so richly deserved. I am delighted that Mr. Lankester-Parker has recently had the opportunity to draw attention to the debt we in Britain owe to the Short Brothers.

I hope your suggestion, regarding an invitation to Mr. Short to tell the story of stress-carrying metal-skinned structures, will be noted and acted upon. This would be some measure of the recognition due, although the omission I have mentioned above ought now to be rectified.

When the last Sunderland in Europe has flown in for the last time at Pembroke Dock, she will serve, not only as an example of our most famous flying-boat, one of our most important aircraft of the last War and our longest-serving operational aircraft. She will be, amongst other things, a lasting testimonial to the World leadership of the Short Brothers in flying-boat development. It is only just that present and future generations should know the value of their work.

Let us hope that, following your admirable and timely editorial, credit will be given where it is due, and honour done, even though belatedly, to a great pioneer.

Cardigan, Wales. PETER F. M. THOMAS.

Low-cost Mass Air Travel

IN a recent issue of THE AEROPLANE AND ASTRONAUTICS (Dec. 2) you refer to an article written by Mr. Peter Masefield, in the *National Provincial Bank Review*, in which he stated that apparently no airline operator had ever asked an aeroplane manufacturer to produce the aeroplane which would have the lowest operating cost regardless of speed or configuration. He suggested that had such a request been made, the most economic cruising speed would probably come out at approximately 480 m.p.h., with ducted fan engines as power-plant. His estimate was that with this arrangement fares could probably be 30% lower than today's levels.

It seems to me, however, that the actual position is rather more hopeful than might be inferred from the above. I am sure that all the airline corporations are keenly aware of the possible benefits to be derived from low-cost mass air travel, and with this in mind, my company has recently put forward proposals for a really cheap-to-operate passenger-carrying aeroplane, namely the H.P.117. This is a laminarized all-wing 300-seater

Groundabout

The Kawanishi Collection? We're not the only people who get sentimental about old flying-boats, it seems. The Japanese Government is negotiating with the U.S. authorities for the return of the *Emily* (code-name) which was taken away after the Japanese surrender. The makers, the former Kawanishi company, would cherish it until a projected national aeronautical museum was ready. Seems surprising, somehow, but they too have their keen types—they even know of *me*. Fall out the man who muttered "So what?"

*

A question of Letters. I don't really know the end of this story, which concerns the C.A.S., Air Chief Marshal Sir Thomas Pike, and a Colonel Post. Prior to their visiting an aircraft carrier by helicopter, the ship received a signal which ran something like this: "ACM PIKE AND POST ARRIVING 1030 HRS." Now when you know that "ACM" can be nautically interpreted as "AIRCREWMAN" you can see the possibilities of the situation. Certainly the Navy afloat at first took it that the postman was coming, although I'm sure the delivery was eventually sorted out and the C.A.S. remained cool, calm and collected.

*

Reactionary

Scene: A meeting of the sales and publicity chiefs of a company making aircraft and gas turbines.

Subject: Their stand at next year's Paris Show.

Sales Manager: "Well, that covers the basic design and the aircraft models—what about the rest of the flotsam?"

P.R.O., a born humorist: "Don't you mean 'jetsam'?"

*

Expensive Round. Seven passengers who became seven unruly drunks on a New York-Montreal flight have paid a $1,400 fine imposed by the Federal Aviation Agency "to bring home the necessity of moderation and decorum aloft."

*

Even I Can Understand. "Not only do we have too many airliners . . . we don't have enough traffic."—*From an American airline's annual report.*

by Gordon

transatlantic aeroplane designed especially to produce the lowest possible operating costs.

In this aircraft the advantages in structure weight and accommodation offered by the all-wing configuration are combined with the drag reduction made possible by boundary layer control through distributed suction. By sucking away some of the boundary layer through slits in the external surface, the boundary layer is enabled to remain laminar with a correspondingly large reduction in skin friction.

The estimated performance of this aeroplane shows that with a cruising speed of 550 m.p.h. a direct operating cost of approximately 0.6d. per passenger-mile can be obtained with a 100% load factor for stage lengths up to 3,500 miles. This, it will be seen, is a higher speed than estimated by Mr. Masefield, and indicates a cost level consistent with his expectation that fares could be some 30% lower than present-day levels.

The suggestion made by Mr. Masefield that the future pattern of air transport may consist of first-class supersonic services, operating simultaneously with a large economy-class traffic carried in highly economical large aircraft flying just subsonically, is obviously a real possibility with aircraft of the H.P.117 type which could be operational a few years sooner than the supersonic airliner.

London, N.W.2. G. H. LEE
(Deputy Chief Designer),
Handley Page, Ltd.

Air Traffic Control by C.G.G.

MAY I respectfully draw your attention to THE AEROPLANE dated Oct. 6, 1937, page 411, para. 2, which is quite surprising considering it was written 23 years ago. I came across it by accident while looking for something else. It is amazing how many sayings by "The Auld Yin," (C.G.G.) are truly prophetic, what a pity that his plea for "Radiaura" and "Planes that won't burn up" have not yet been heeded.

Glasgow, S.4. L. DOUGLAS GILLIES.

C.G.G. wrote:—

"Here is a subject which the air experts of the daily press might well take up, if they want something that will benefit aviation and, at the same time, be sensational enough for the debauched mental taste of the average reader of the average newspaper. I present the title free of copyright fees to Fleet Street.

"The fact is that day by day we are getting nearer and nearer to a colossal collision in the air which will give the newshawks and the sub-editors and the sob-stuff writers enough material to provide one of the greatest sensations the air has ever produced."

Later in the same article he writes:—

"As I have said earlier in this article, control officers have no power to enforce their orders or instructions, which consequently become merely good advice. And nothing is cheaper to get and easier to neglect than good advice. Quite definitely what is needed is an amendment of the Air Navigation Act, or at any rate a legal interpretation of the Air Navigation Act, which makes disobedience of orders from the Control Tower a criminal offence.

"If a soldier on active service disobeys orders he is liable to be shot, or at any rate he is liable to very severe penalties. Every pilot who is flying with a load of passengers or without passengers for that matter, is on active service. And he ought to be subject to the same penalties.

"People can be fined and imprisoned under the Air Navigation Act for all sorts of silly things. They can be run in on the evidence of some thick-headed bucolic policeman on a charge of flying dangerously low over an inhabited area where no danger exists. Several pilots have been arrested and fined for smuggling, including importing dogs contrary to the quarantine arrangements. But there is no penalty for endangering the lives of other people in the air through disobedience of advice from the Control Tower."

Fatality Rate Statistics

IN your useful article on "Airlines of the World" in your issue of Nov. 11, p. 642, you show a table which includes a column of "Total accidents per 100,000 aircraft hours flown." This is the first time I have seen such statistics based on hours and I hope it will always be done in future. After all, a man lives three-score years and ten and it is the proportion of this time spent flying which counts. Space travel would look very safe on a miles basis. It is thought by many that flying is safe compared with other forms of transport. Consider the figures below:—

STATISTICS—COMPARATIVE TRANSPORTATION SAFETY RECORD—UNITED STATES: 1948–57

Passenger fatalities and rate of passenger fatalities per 100 million passenger miles.

Year	Passenger automobiles and taxicabs		Buses		Railroad passenger trains	
	Number	Rate	Number	Rate	Number	Rate
1948 ..	15,200	2.1	120	0.18	52	0.13
1949 ..	15,300	2.0	120	0.20	29	0.08
1950 ..	17,600	2.2	100	0.17	184	0.58
1951 ..	21,000	2.4	130	0.22	150	0.43
1952 ..	22,600	2.8	100	0.16	14	0.04
1953 ..	23,500	2.9	70	0.13	50	0.16
1954 ..	22,500	2.6	60	0.11	23	0.08
1955 ..	24,700	2.7	100	0.19	19	0.07
1956 ..	26,100	2.7	80	0.16	57	0.20
1957 ..	25,700	2.6	70	0.13	15	0.06

Surface transport data from the National Safety Council's "Accident Facts."

Let us assume that the average speed of cars and taxis in America during these years was 30 m.p.h., of buses 25 m.p.h. and of trains 50 m.p.h.

The fatality rates per 100 million passenger hours (averaged for all the years) then become: Cars and taxis 75, buses 4, trains 9. Compare with the figure for aircraft of 330!

Another method of comparison is to compare the cost of life insurance for the drivers. A railway engine driver, a bus driver or a taxi driver are all treated as ordinary persons but the civil pilot has a special, more expensive, policy.

Avon. A. H. CRAWSHAW.

Aviation Calendar

Jan. 6

Cranfield.—R.Ae.S., College of Aeronautics and British Interplanetary Society joint Symposium. "Rocket Propulsion," at the College of Aeronautics; until Jan. 7.

Jan. 9

London.—R.Ae.S. Historical Group lecture. "Rebuilding and Flying Historic Aeroplanes," by Air Cdre. A. H. Wheeler, in the Lecture Theatre, 4 Hamilton Place, W.1, at 19.00 hrs.

Jan. 10

Luton Airport.—R.Ae.S. Branch lecture. "Supersonic Transport," by R. G. Thorne, in the Napier Senior Staff Canteen, at 18.00 hrs.

Jan. 11

Southend.—R.Ae.S. Branch lecture. "M.A.T.S. Operations," by a member of the U.S.A.F. Air Transport Wing, in Room 3, Engineering Dept., Municipal College, London Road, at 19.30 hrs.

Hayes.—R.Ae.S. L.A.P. Branch lecture. "New Horizons for Forging," by E. T. Stewart-Jones, in the Lecture Hall, Fairey Aviation Co., at 18.00 hrs.

Jan. 12

London.—R.Ae.S. Lecture. "The Law and Science in Aeronautics," by H. Caplan, in the Lecture Theatre, 4 Hamilton Place, at 18.00 hrs.

London.—Institute of Metals lecture. "Metallurgical Research at High Pressure," by Dr. J. E. Hilliard, at the Institute's H.Q., at 18.30 hrs.

Jan. 13

Birmingham.—The Society of Instrument Technology Midland Section lecture. "Controls Associated with Flying," by Capt. A. M. A. Majendie, in the Lecture Theatre, Byng Kendrick Suite, Gosta Green College of Technology, at 19.00 hrs.

London.—R.Ae.S. Rotocraft Section lecture. "Artification of Civil Transport Rotocraft with Particular Reference to Multi-engines," by H. E. le Sueur, in the Lecture Theatre, 4 Hamilton Place, W.1, at 18.00 hrs.

Company Notices

NEW COMPANIES

Titan Airways, Ltd. (677,107).—Private co. Reg. Dec. 6. Cap. £15,000 in 60,000 deferred ordinary shs. of 1s., 7,000 ordinary and 5,000 10% non cumulative preference shs. of £1 each. Aerial communication, etc. Sec.: W. C. Williams. Reg. off.: Polebrook House, Upper James Street, W.1.

OVERSEAS COMPANIES

Persian Air Services (F.4974).—Particulars filed Nov. 29, 1960. Cap. Rials 10,000,000 in 1,000 shs. of Rials 10,000 each. Reg. in Persia to carry on air transportation of passengers and freight. British address: 1 Grafton Street, W.1. K. F. Lyons, of 91 Grange Park Rd., Leyton, E.10, is authorized to accept service of process and notices.

INCREASE OF CAPITAL

British United Airways, Ltd. (233,961). (formerly Airwork, Ltd.). 35 Piccadilly, W.1. Increased on May 12, 1960, by £160,000 in £1 ordinary shares, beyond the reg. cap. of £350,000.

CHANGES OF NAME

Vickers-Armstrongs (Aircraft), Ltd. (542,020). Vickers House, Broadway, Westminster, S.W.1. Name changed to Vickers Aircraft Holdings, Ltd., on Jne. 14, 1960.

Vickers-Armstrongs Aircraft (1960), (650,323). Vickers House, Broadway, S.W.1. Name changed to Vickers-Armstrongs (Aircraft), Ltd., on Jne. 14, 1960.

New Patents

APPLICATIONS ACCEPTED

860,823.—**Vickers Aircraft Holdings, Ltd.**—"Pivot bearings."—Apr. 18, 1956. (Apr. 26, 1955.)

860,497.—**Daimler-Benz A.G.**—"Turbo-jet propulsion units in aircraft."—May 1, 1959. (May 2, 1958.)

860,432.—**Electro-Hydraulics, Ltd.**—"Retractable undercarriages for aircraft."

Printed specifications of the above will be available on Feb. 8, 1961, and the opposition period will expire on May 8, 1961.

Personal Notices

BIRTHS

Elkington.—On Dec. 16, at Moreton-in-Marsh Hospital, to Patricia, wife of Sqn. Ldr. J. F. D. Elkington—a daughter.

Grant.—On Dec. 13, at B.M.H., Singapore, to Constance (*née* Pickford), wife of Flt. L. H. Grant—a son.

Howden.—On Dec. 12, at Westwood Hospital, Beverley, to Shelia (*née* Barclay), wife of Flt. Lt. R. I. C. Howden—a son.

Kelsey.—On Dec. 16, at Leuchars, Fife, to Judith (*née* Longley), wife of Flt. Lt. W. Kelsey—a son.

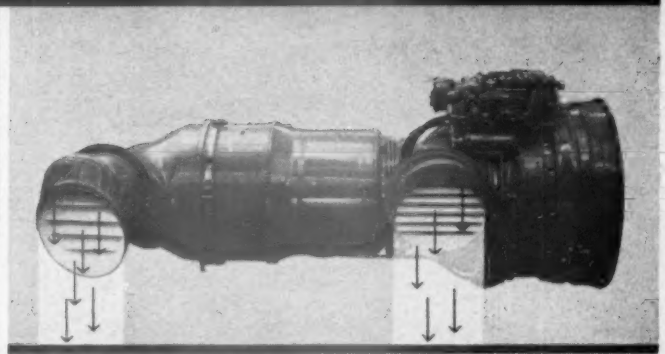
Leighton.—On Dec. 10, at West Norwich Hospital, to Florence, wife of Flt. Lt. Leighton—a son.

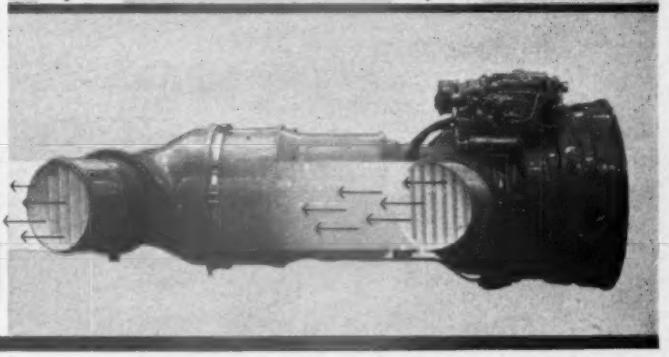
Lemon.—On Dec. 8, in Hong Kong, to Pamela (*née* Salmon), wife of Flt. Lt. Brian Lemon—a son.

DEATH

Eccles.—On Dec. 14, Gp. Capt. William Eccles, O.B.E., M.S.M., R.A.F. (Retd.).

LIFT and THRUST from ONE ENGINE— the Revolutionary BS 53 Turbofan





...ANOTHER ENGINEERING ADVANCE BY BRISTOL SIDDELEY

The new Bristol Siddeley BS 53 high-ratio turbofan represents a major engineering breakthrough in the field of aircraft propulsion. Because the BS 53 can be fitted with movable nozzles evenly disposed around the centre of gravity which give directional control to its total thrust, this remarkably versatile engine provides the airframe designer with a *single power source for all conditions of flight.*

VTOL, STOL and normal take-off capability in the same aircraft. Suitable for subsonic or supersonic applications.

High cold-flow ratio gives high thrust for low weight, low fuel consumption and low noise level.

Conventional installation. Operational simplicity. Independent of all fixed ground installations.

Problems of ground erosion, recirculation and ingestion of debris reduced to a minimum.

The Bristol Siddeley BS 53 has already been selected for, and is now undergoing trials in, the Hawker P 1127 VTOL light strike fighter and is supported by the Mutual Weapons Development Programme for NATO.

BRISTOL SIDDELEY ENGINES LIMITED

THE AEROPLANE and ASTRONAUTICS CLASSIFIED ADVERTISEMENTS

PRESS DAY: Classified Advertisements must normally be received at Head Office by FIRST POST THURSDAY for the following Friday week's issue. Last-minute additions and deletions are accepted by telephone from trade advertisers up to noon. Advertisements received too late for a particular issue are automatically inserted in the succeeding one unless instructions to the contrary are received.

RATES—1/- per word (minimum 12 words 12/-). Each paragraph charged separately and name and address must be paid for. Semi-displayed setting £3-17-6 per single column inch. Centred lines 22/6. Series discounts of 5% for 13, 10% for 26 and 15% for 52 consecutive insertions, allowed to trade advertisers.

TERMS—Strictly net and prepayable. Monthly accounts for settlement by the end of the month following insertion are allowed to trade advertisers if satisfactory references are provided.

REMITTANCES—Cheques and postal orders should be crossed and made payable to TEMPLE PRESS LIMITED and instructions sent addressed to the Manager, "The Aeroplane and Astronautics," Bowling Green Lane, London, E.C.1.

DEPOSIT SYSTEM—Facilities are available to readers to purchase advertised goods through "The Aeroplane and Astronautics." Commission 1% (minimum 2/-) on amount deposited.

BOX NUMBERS—Private advertisers desiring to have replies sent care of "The Aeroplane and Astronautics," may do so on payment of 1/- to cover booking and postage, plus cost of four extra words. Box Numbers must not be used for the purpose of circularizing and the Proprietors do not undertake the distribution of such matter received. To avoid mistakes in forwarding, Box Numbers should be carefully and legibly copied and replies sent to Box A000, care of "The Aeroplane and Astronautics," Bowling Green Lane, London, E.C.1.

THE PROPRIETORS retain the right to refuse or withdraw advertisements at their discretion and are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

HEAD OFFICES: Bowling Green Lane, London, E.C.1, England. Telephone: Terminus 3636. Telegrams: "Pressimus London Telex." Telex: 23839.

BRANCH OFFICES: Bayliss House, Hurst Street, Birmingham, 5. Telephone: Midland 6616. 50 Hertford Street, Coventry. Telephone: Coventry 27414. 1 Brazennose Street, Manchester. Telephone: Deansgate 6114–8. 12 Renfield Street, Glasgow. Telephone: Glasgow Central 1413.

EUROPE'S LEADING AIRCRAFT BROKERS

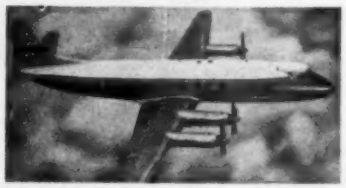
TRANSPORT AIRCRAFT DIVISION

At the moment we can offer for sale used Viscounts of the early 700 Series, the 700D Series, the 770D Series, and the 800 Series. With more than 400 Viscounts in airline service the number available on the used market is extremely few. Our World-wide contacts and representatives enable Shackleton's to maintain an accurate and detailed picture of those Viscounts available on the one hand and potential customers on the other. We shall be happy to place this service at your disposal —for Viscounts or any other transport aircraft.

Ref. 3165.
Six early 700 Series Viscounts, fitted with Rolls-Royce Dart 506 engines. Operated by a national airline since new, maintained in beautiful condition and now offered for immediate delivery at a very attractive price. Fuel capacity 1,720 imperial gallons, 10" stroke undercarriage, 57/60,000 lb. all-up weight.

Ref. 3023/4.
Two early 700 Series Viscounts with Dart 506 engines. Current British C. of A. Fitted as 49 or 58 passenger seat aircraft and offered for sale or charter. Fuel capacity 1,720 imperial gallons, 10" stroke undercarriage, 57,000 lb. all-up weight.

VICKERS VISCOUNTS



There has been a stimulating demand for these aeroplanes in recent months and our staff have visited Europe, the Middle East and the Far East during this period conducting negotiations with Vickers Viscounts.

Ref. 2814.
Two 700D Series Viscounts with Dart 510 engines offered for sale only. Passenger cabin with 50 seats. Fuel capacity 1,946 imperial gallons, 12" stroke undercarriage, 63,000 lb. all-up weight.

Ref. 3166.
Three 700D Series Viscounts with Dart 510 engines, offered for sale but charter terms will also be considered. 48 passenger seating accommodation. Delivery in Spring of 1961. Fuel capacity 1,946 imperial gallons, 12" stroke undercarriage, 63,000 lb. all-up weight.

Ref. 3167.
Two 770D Series Viscounts with Dart 510 engines. Equipped with 48 passenger seats. These two aircraft are probably the best value in used Viscounts presently on offer. Fuel capacity 1,904 imperial gallons, 14" stroke undercarriage, 63,000 lb. all-up weight.

Ref. 2823/4.
Two 770D Series Viscounts with Dart 510 engines. Again equipped with 48 passenger seats and the latest 700 Series Viscounts presently available on the used market. Fuel capacity 1,904 imperial gallons, 14" stroke undercarriage, 63,000 lb. all-up weight.

Ref. 2856.
One 800 Series Viscount with Dart 510 engines. We believe this is the only 800 Series Viscount being offered for sale on the used market. Seating for 72 passengers using double and triple type seats. Fuel capacity 1,938 gallons. 64,500 lb. all-up weight.

W. S. SHACKLETON (AVIATION) LTD

175 PICCADILLY · LONDON · W.1

TELEPHONE: HYDE PARK 2448/9 CABLES: SHACKHUD, LONDON

AIRCRAFT FOR SALE

R. K. DUNDAS, LTD.

1960 AUTOFLITE COMANCHE 250.

WHAT a magnificent purchase this could make for someoody. A globe-trotting wonder that could bring you many, many hours of unsurpassed, efficient, luxurious, safe flying.

THE one we offer has only flown 110 hr. t.t. since new, as an Autoflite model it includes all S.C extras. You thus have an aircraft with VHF, VOR/ILS, MARKER, ADF, cabin speaker, Autopilot, full panel, dual control, full night flying equipment, 1,000-mile range, 180 m.p.h. cruise, to mention but a few of the points on this fine aircraft. At £8,950, it is more than £2,300 off list price. The colour is red and white with matching interior and the condition is literally as new.

R. K. DUNDAS, LTD., Dundas House, 59 Saint James's St., London, S.W.1. Phone, Hyde Park 3717. 568-13

PIPER TRI-PACER, 1956. Lycoming 150 h.p. engine, engine hours since complete overhaul 48, total airframe hours 1,463 since C. of A. 48. C. of A. expiring 22.5.61, full blind flying panel, Narco Simplexer 27-channel V.H.F. with VOR attachment and 75 M/cs. marker beacon receiver, £3,350 o.n.o. Immediate delivery.

PETER S. CLIFFORD AND CO., LTD., Tresa, Kirtlington, near Oxford. Phone, Kidlington 3355; Bletchington 392. 568-7

PBY5A.

TWO AMPHIBIANS CONVERTED FOR TWO-CREW CARGO-PASSENGER USE.

BOX A404.

Care of THE AEROPLANE AND ASTRONAUTICS.

568-4

£2,800 Will buy a brand-new 3- to 4-seater Jodel DR1050 with a cruising speed of 120 m.p.h. on 4 gallons per hour. Can you think of any other new aircraft with comparable economics? No?—Then contact: Rollason Aircraft and Engines, Ltd., Croydon Airport, Surrey. Phone, Croydon 5151-2. 568-10

PIAGGIO *of GENOA*

P.166, the Executive with airliner comfort: fully reclining armchairs, ample headroom, toilet, buffet, picture windows *and the straight-in step*

British Representatives

AERO-ENTERPRISES (Boreham Wood) Ltd

17 Drayton Rd, Boreham Wood, Herts: ELS 2688

VIGORS FOR PIPERS

KIDLINGTON 3444/5 OXFORD

GRANTAIR, LTD.,

GRANTCHESTER, CAMBRIDGE.

Phone, Trumpington 3132 (24 hours per day).

YOU have a licence—we have aircraft. Recent C. of A. (private or hire and reward). H.P. or leasing. British and American, 2, 4, or more seats, with or without radio, £1,000 to £10,000. Demonstrations anywhere any time. Hire one for a week before you buy it. See also aircraft for hire and charter. zzz-768

FOR SALE.

C-46F AIRCRAFT.

PASSENGER AND CARGO.

WITH OR WITHOUT

T-CATEGORY KIT INSTALLED.

IMMEDIATE DELIVERY.

THE FLYING TIGER LINE, INC.,

BURBANK, CALIF.

CALL OR CABLE.

FRED BENINGER,

EXECUTIVE VICE-PRESIDENT.

Phone, Stanley 7-3411. Cable, "Flytiger." 568-733

A VIKING Mark I, 200 hours, available immediately. Full specification and details from P. E. Palmer Holdings, Ltd., Canopus Court, Hurn Rd., Ringwood, Hants. 568-x930

Aircraft for Sale—contd.

VISCOUNTS offered on lease-purchase agreements or other charter basis by the owners, Maitland Drewery, 128 Station Rd., Sidcup.. Phone, Foo 6761. 568-9125

EXECUTIVE

DE HAVILLAND DOVE.

TOTAL TIME 1,146 HR.

BOX A403.

Care of THE AEROPLANE AND ASTRONAUTICS. 568-3

1959 Beechcraft Travel Air 95, blue-silver, engine hours nil since major overhaul, regularly maintained, STR12D, Narco Omnigator, Sunair RTR, Lear 12E, demonstration by arrangement at short notice. Box A662, care of THE AEROPLANE AND ASTRONAUTICS. 568-9

Aircraft Wanted

SCRAP aircraft aluminium and stainless steel urgently required. Lowton Metals, Ltd., Lowton St. Mary's, near Warrington. Leigh 71441-2. zzz-0766

LIGHT aircraft required, exchange month-old £900 car, cash adjustment. Whyham, 133 Squires Gate Lane, Blackpool. 568-11

TIGER Moth aircraft required for private flying group, should be in good condition, new or recent C. of A. with low engine hours. Preferably with inter-com. J. Hoseason, 89 Bridge Rd., Oulton Broad, Lowestoft. 568-12

AIRCRAFT ACCESSORIES, SPARES AND COMPONENTS

THE REGIONAL AIR TRADING CO., Croydon Airport for Rapide spares of every description. Phone, Croydon 8521. zzz-762

REPAIRCRAFT, LTD., The Common, Cranleigh, Surrey (Cranleigh 536), for instruments and auto-pilot overhaul. zzz-749

PHILLIPS AND WHITE, LTD.

THE leading stockists in the U.K. for instruments, navigational equipment, electrical components and parts, and engine accessories. Spares for de Havilland Gipsy, Major and Queen series, and Armstrong Siddeley Cheetah IX, X and XV engines.

61 QUEEN'S GARDENS, London, W.2. Phone, Ambassador 8651, 2764. Cables, "Gyrair, London." zzz-772

SKY TRADE (COMPONENTS), LTD., approved stockists for Tiger Moth and Rapide spares, large selection available from stock. Croydon Airport. Cro 9433. 568-9097

ROLLASONS for Tiger Moth spares, Gipsy engine overhauls and spares and now increased facilities at Biggin Hill for your C. and A. overhaul. All light aircraft types acceptable. zzz-775

PLUGS and sockets. More than 1,000,000 in stock, covering over 50 different ranges. British and American. Stock list on application to: Sasco Nutfield, Redhill, Surrey. Phone, Redhill 5050. zzz-776

PARACHUTES, 24-ft. nylon back-type, £10 each, ditto seat-type, £8 each; also 18-ft. canopy retarders, £3 10s. each. H. H. Bradford, Ltd., Ramsey, Harwich, Essex. 569-x890

FOR SALE.

SPARE PARTS INVENTORY

FOR

C-46, DC-4, DC-6, 1049H

CONSTELLATION AIRCRAFT.

ALSO

WRIGHT COMPOUND

3350-EA-3 ENGINES.

PRATT & WHITNEY

R2800 CB16/17 ENGINES.

THE FLYING TIGER LINE, INC.,

BURBANK, CALIF.

CALL OR CABLE

DOUG DULY.

Phone, Triangle 7-3411. Cable, "Flytiger." 568-0723

AIRFRAME spares for Dakotas, Harvards, Piper Cub, Fairchilds, Argus, Beechcraft, D-17s, Mosquito, Spitfire, Firefly. Engine spares for Pratt & Whitney, Armstrong Siddeley, Lycoming, etc., accessories and instruments for all types of aircraft.

C.47 Dakota operators please note, we offer a limited number of genuine brand-new Bendix 52058 tail wheels at a reasonable price.

A. J. WALTER, LTD., The Drive, Horley, Surrey. Phone, Horley 1420 and 4294. Cables, "Cubeng Horley." 568-2

Keegan Aviation LTD

What we advertise —we own

Transport Aircraft in Stock

	Location
2 DOUGLAS DC4's	(Ringway)
4 VICKERS VIKINGS	(Southend)
1 BRISTOL 170 MK 21	(L.A.P.)

Executive Aircraft in Stock

2 D.H. DOVES	(Panshanger)
1 AERO COMMANDER	,,
1 CESSNA 310	,,
1 SUPER CUSTOM APACHE	,,

All these aircraft are in the U.K.

All can be leased or bought.

All can be inspected daily.

★ ★ ★

Full specifications will be sent by return post, we will trade in from DC4's down, and will negotiate the best prices obtainable in the World—buy or lease.

Keegan Aviation LTD

PANSHANGER AERODROME HERTFORD

Tel.: Essendon 491-2-3
Cables: Planesales, Hertford
Telex: 1943

AIRCRAFT SERVICING

OVERSEAS AIR TRANSPORT, LTD., Manchester Airport, for overhauls, conversions and modifications at guaranteed prices. Phone, Mercury 5262, ext. 148. zzz-779

HELICOPTERS

FOR specialized helicopter operations in Engineering and Survey, Agricultural Spraying, Passenger Transport, Flying Training — Contact Helicopter Services, Ltd., Luton Airport. Phone, Luton 4911. zzz-773

CLOTHING

R.A.F. Officers' uniforms for sale, new and reconditioned. Fisher's, 86-88 Wellington St., Woolwich. Phone 1055. Kit also purchased. zzz-774

CONSULTANTS

R. H. STOCKEN, F.R.Ae.S., Eagle House, 109 Jermyn St., S.W.1. Whitehall 2777-8. zzz-743

IAN L. S. McNICOL, London School of Air Navigation. Pilot and navigator training with advisory service. 33 Ovington Square, Knightsbridge, S.W.3. zzz-746

R. W. SUTTON (CONSULTANTS), LTD., 7 Landsowne Place, Cheltenham. Phone 5811. 575-9121

ELECTRICAL EQUIPMENT

ELECTRICAL connectors. More than 1,000,000 in stock, covering over 50 different ranges. British and American. Stock list on application to Sasco, Nutfield, Redhill, Surrey. Phone, Redhill 5050. zzz-777

ENGINES AND ENGINE SPARES

ENGINE overhauls. Hants and Sussex Aviation, Ltd., offer Britain's most comprehensive overhaul service, including magneto and component overhaul, with spares supply. All D.H. range up to Queen 30 Mk. 2 for Heron. Armstrong Siddeley, Blackburn Cirrus, Lycoming and United Kingdom distributors of Continental motors. Huge exchange pool most type engines. Specialists in export work. Address, The Airport, Portsmouth, Hants. Phone 63051. 568-693

Engines Wanted

WANTED: A reconditioned Cirrus Major III engine for Auster. Full details and price to Box A681, care of THE AEROPLANE AND ASTRONAUTICS. 569-502

HANGARS

B.1. Hangar, 227 ft. by 121 ft. Clad with new galvanized sheets, now standing on site at Lichfield. £5,500; one ditto, but framework only, no ends, dismantled and ready for loading on to lorries, £5,250.

WESCOL, Northowram, Halifax. Phone 68168. 569-9133

HIRE AND CHARTER

GRANTAIR, LTD.

GRANTCHESTER, CAMBRIDGE.

Phone, Trumpington 3132 (24 hours per day).

You have a licence—we have aircraft with or without pilot, with or without radio, two or four seats. Tri-paciers, Caribbeans, Cubs or Austers, for hire or lease. (Free maintenance, insurance and repairs.) From £3 10s. per engine hour without pilot or 1s. 3d. per mile with pilot.

Europe—Africa or Asia covered. See also Aircraft for Sale. zzz-769

PACKING AND SHIPPING

R. AND J. PARK, LTD., 143-9 Fenchurch St., E.C.3. Phone, Mansion House 3089. Official packers and shippers to the aircraft industry. zzz-674

RADIO AND RADAR

SPERRY ZERO reader, Type ZLI course selectors, control panels, flight computers and indicators, three complete installations in stock. A. J. Whittemore (Aeradio), Ltd., Biggin Hill Aerodrome, Kent. zzz-780

STR12D, STR9Z, STR9X and most other British and American V.H.F. R/T equipment always in stock. A.R.B.-approved design installations into any type of aircraft. A. J. Whittemore (Aeradio), Ltd., Biggin Hill Aerodrome, Kent. zzz-781

SITUATIONS VACANT

A.F.R.Ae.S., A.R.B.Certs., A.M.I.Mech.E., etc., on "No pass, no fee" terms. Over 99% successes. For details of exams. and courses in all branches of aeronautical work, aero engines, mechanical engineering, etc., write for 48-page handbook—free. B.I.E.T. (Dept. 703), 39 Wright's Lane, London, W.8. zzz-740

AERIAL FARM SERVICES, Biggleswade, Beds, require single young men for ground crews. Driving licence essential. 568-14

FIRST officers required by Cathay Pacific Airways, Ltd., Hong Kong. Applicants should be under 30 years of age and must hold the following qualifications:—

U.K. Or Colonial commercial pilots licence instrument rating; R.T. licence; passed group A performance examination; DC-6/6B and/or Electra endorsements will be considered an advantage.

FORWARD applications to Operations Manager, Cathay Pacific Airways, Ltd., P.O. Box 4, Hong Kong. 569-501

Situations Vacant—contd.

CHIEF Flying Instructor and Charter Pilot required at aerodrome in the south. Applicants, stating age, experience and licences held, together with expected remuneration, should apply to Box A672, care of THE AEROPLANE AND ASTRONAUTICS. 568-x903

MINISTRY OF AVIATION: Air Traffic Control Officers. Posts for men or women at least 23 and under 35 on 1.7.61. Candidates must have had recent aircrew experience, preferably as pilot or navigator in civil air transport or H.M. Forces; but exceptionally, extensive experience in A.T.C.O. duties may be accepted. They should normally also have G.C.E. with five passes, or an equivalent academic qualification. Starting salary (London) from £825 to £1,190. Maximum £1,522. Appointments initially unestablished, but prospects of establishment and promotion. Write Civil Service Commission, Burlington Gardens, London, W.1, for application form, quoting S227/61. 568-6

PETTERS, LIMITED,
A MEMBER OF THE HAWKER SIDDELEY GROUP,
REQUIRE A
DEVELOPMENT ENGINEER
FOR RESEARCH INTO COOLING PROBLEMS ASSOCIATED WITH AIR-COOLED PETROL AND DIESEL ENGINES INCLUDING FAN DESIGN AND PERFORMANCE.

Previous engine experience is not essential but candidates must have experience of fluid flow.
Persons with experience of wind tunnel testing would be considered.
A generous salary will be offered to the right applicant and conditions of service are excellent. Please apply to H. W. MARSDEN, ESQ., Personnel Manager,
PETTERS, LIMITED,
STAINES, MIDDLESEX. 568-8

BRITISH UNITED AIRWAYS require pilots to fly Twin Bonanza and Twin Apache aircraft based Nigeria, minimum requirements C.P.L. with I/R. Applications in writing, stating experience, to British United Airways, Helicopter Division, Redhill Aerodrome, Surrey. 569-500

JERSEY AIRLINES
HAVE VACANCIES
BASED IN JERSEY
FOR
A AND C LICENSED ENGINEERS,
DART AND PRESSURISED AIRCRAFT ENDORSEMENT PREFERRED.

Salary scale: £926 to £1,004.
Shift Pay and Sundays extra.
Superannuation Scheme after probationary period.
Jersey rates of income tax.
Applications to:—
PERSONNEL OFFICER (ENGINEERING),
JERSEY AIRLINES,
STATES AIRPORT,
JERSEY. 568-1

BRITISH UNITED AIRWAYS require pilots for overseas contracts. Generous allowances. Apply Chief Pilot (Morton Division), Gatwick Airport. 568-5

SITUATIONS WANTED

COMMERCIAL Pilot instrument rating, 2,800 hours command twins 3,100 total; 8 years aircraft maintenance engineering. Available immediately, seeks situation home or overseas. Box A682, care of THE AEROPLANE AND ASTRONAUTICS. 568-x956

TUITION

AVIGATION, LTD., provides full-time or postal tuition or a combination of these methods for M.C.A. Pilot/Navigator licences. Classroom instruction can be provided for A.R.B. General, certain specific types and performance schedule examinations. D4 Links. Phone, Rodney 8671. For details apply Avigation, Ltd., 30 Central Chambers, Ealing Broadway, London, W.5. Ealing 8949. zzz-771

MINISTRY-APPROVED Trainers. For instrument rating practice come to us, the recognized specialists for 12 years. Link Training Services, Ltd., 33 Ovington Square, London, S.W.3. Knightsbridge 2069. 568-9094

LONDON SCHOOL OF AIR NAVIGATION offers full-time personal coaching with home-study correspondence courses or combination of both for all aspects of professional pilot and navigator qualifications; also P.P.L. Officially appointed Services Courses Scheme. 33 Ovington Square, Knightsbridge, London, S.W.3. Ken 8221. zzz-755

DENHAM LINK TRAINING CENTRE. £1 seven-day week. Denham 2161 and 3171. zzz-741

ADCOLA
(Regd. Trade Mark)
SOLDERING EQUIPMENT

THE ELECTRONIC INDUSTRIES SOLDERING TOOL FOR THE TRANSISTOR AGE.

ILLUSTRATED
⅛" Bit Model
(Cat: No. 70)

MANUFACTURED IN ALL VOLT RANGES

DESIGNED FOR CONTINUAL USE ON BENCHLINE ASSEMBLY

PROTECTIVE SHIELD
(Cat: No. 68)

British & Foreign Patents Reg. Designs etc.

Catalogues from Head Office, Sales & Service
ADCOLA PRODUCTS LTD.
GAUDEN ROAD, CLAPHAM HIGH STREET
LONDON, SW4
Telephones: MACaulay 3101 & 4272

CROSS
PERFECT PRECISION AIRCRAFT SPRING WASHERS
TO B.S. SPECIFICATION 2 SP.47
CROSS MFG. CO. (1938) LTD
COMBE DOWN, BATH. Tel.: Combe Down 2356

B. S. T. AERONAUTICAL LTD
A.R.B. APPROVED
C47 - DC3 Specialists

1. A.N. Materials, Filaments, Voltage Regulators, Reverse Current Relays
2. Main Wheels complete, Wheel and Brake Spares
3. Pumps, Starters, Generators, Tacho Generators, Vibrators
4. Engine Mounts, Bolts, Bushes, Sandwich Rubbers
5. Anti-drag Rings complete, Flap Assemblies and Spares
6. Hydraulic Regulators, Selectors, Retracting and Compensating Jacks

84 ALEXANDRA ROAD
FARNBOROUGH HANTS.
Telephone FARNBOROUGH 2881/2/3

EXETER AIR CENTRE offers the least expensive and most comprehensive flying training available today, contract rates from £3 7s. 6d. per hour. Normal Auster/Tiger rate £3 12s. 6d., Chipmunk £5 5s. P.P.L. courses from £108 15s., C.P.L. from £665. Instructor's course from £72 10s. Special attention to individual requirements. Full Air Traffic Control. Radio aids VHF/DF and 24-hour Met. service, grass or runways. Local accommodation from £3 10s., airport £5 15s. 6d. Exeter Airport, Ltd., Exeter 67433. zzz-778

SOUTHEND-ON-SEA MUNICIPAL FLYING SCHOOL, commercial and private pilots' training, night flying every night; Austers and Chipmunks from £4. No entrance fee or subscription. Municipal Airport, Southend-on-Sea, Essex. Phone, Rochford 56204. 568-747

CLUB NOTICES, ETC.

SURREY AND KENT FLYING CLUB, Biggin Hill (BN99 2255. M.o.A.-approved course. Tiger and Hornet Moths, Chipmunks and Prentice. Contract rates. Route 705, one hour from Victoria. 568-761

BOOKS AND PUBLICATIONS

THE EXPLORATION OF SPACE (First Cheap Edition), by Arthur C. Clarke. Provides answers to the many questions the intelligent layman asks about the science of "astronautics." Over 375,000 copies sold in all editions. Illustrated, 212 pages, 8s. 6d. net from booksellers, or 9s. 5d. by post from the publishers, Temple Press Limited, Bowling Green Lane, London, E.C.1. zzz

THE "POWER AND SPEED" SERIES FOR BOYS "Aircraft and Air Power," by F. G. Swanborough, of THE AEROPLANE AND ASTRONAUTICS, has been written for intelligent boys between the ages of 10 and 16. The author surveys modern military flying and includes chapters on combat aircraft, scientific aids and missiles. Other titles in this series are "Motorcars," "Locomotives" and "Ships and Shipbuilding." Illustrated, 112 pages, 10s. 6d. net from booksellers, or 11s. 5d. by post from the publishers, Temple Press Limited, Bowling Green Lane, London, E.C.1. zzz

"CAMERA IN THE SKY," by Charles Sims, with a preface by Air Chief Marshal Sir James Robb. For more than 30 years Charles Sims, chief photographer of THE AEROPLANE AND ASTRONAUTICS and one of Britain's best-known aerial photographers, has watched the amazing growth of British aviation from a ring-side seat. In this book he recalls with pen and camera, enlivened with anecdote, some of his many memories of those eventful days. Illustrated, 218 pages, 25s. net from booksellers, or 26s. 6d. by post from the publishers, Temple Press Limited, Bowling Green Lane, London, E.C.1. zzz

"THE AEROPLANE" PICTORIAL REVIEW (No. 4). Compiled by the staff of THE AEROPLANE AND ASTRONAUTICS. In this fourth annual miscellany of the most interesting photographs to have appeared in the pages of THE AEROPLANE AND ASTRONAUTICS, there are over 230 photographs grouped for ease of reference in 12 sections. New features are a Farnborough Display section and an index providing a ready reference to all makes of aircraft and missiles. Illustrated, 128 pages, 12s. 6d. net from booksellers, or by post, 13s. 7d. from the publishers, Temple Press Limited, Bowling Green Lane, London, E.C.1. zzz

PRINCIPLES OF HELICOPTER ENGINEERING, by Jacob Shapiro. This comprehensive review of the engineering principles governing the design and construction of helicopters provides a complete survey of present knowledge in the field. Illustrated, 448 pages, 55s. net from booksellers, or 56s. 9d. by post from the publishers, Temple Press Limited, Bowling Green Lane, London, E.C.1. zzz

NEW BALL & ROLLER BEARINGS
Over 5,000,000 in stock
in more than 5,000 types
BRITAIN'S LARGEST STOCKS
WRITE FOR STOCK LISTS
CLAUDE RYE BEARINGS
895-921, FULHAM RD., LONDON, S.W.6
Phone: RENOWN 6174 (EXT. 24) TELEX 23453

FREE! TO AMBITIOUS ENGINEERS 144-PAGE BOOK

Full details of the easiest and quickest way to prepare for A.F.R.Ae.S., A.R.B. Licences, B.Sc.(Eng.), A.M.I.Mech.E., City & Guilds, and hundreds of Home Study Courses in all branches of Aeronautical, Mechanical & Electrical Eng., Draughtsmanship, R.A.F. Maths., etc., are given in this valuable book. Our Courses have been approved by Royal Aeronautical Society and many B.I.E.T. Students have obtained First Places in the A.F.R.Ae.S. Exams.
We definitely Guarantee
NO PASS—NO FEE
A copy of this enlightening Guide to well-paid posts will be sent on request—
FREE! Write: B.I.E.T., 900a COLLEGE HOUSE, 29-31, WRIGHT'S LANE, LONDON, W.8.
BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

BRITISH
WIRE THREAD INSERTS

Precision made in Carbon Steel for Aluminium and Magnesium. Also in Stainless Steel and Bronze.

B.S.F. · Metric · B.S.P. · B.A.
Whitworth · Unified

CROSS MANUFACTURING CO. (1938) LTD
COMBE DOWN BATH SOMERSET
'Phone: COMBE DOWN ... 'Grams: CIRCLE BATH

AEI

Associated Electrical Industries Limited
(ELECTRONICS DIVISION)

SALES ENGINEER

Associated Electrical Industries Limited have a vacancy for a Sales Engineer in their MILITARY RADAR SALES DEPARTMENT. Applications are invited from Engineers with an electronics background, who possess A.M.I.E.E. or equivalent, and have had experience in some branch of Military or Civil Radar.

Please write for Application Form quoting reference V.17 to :—

Personnel Manager
Associated Electrical Industries (Manchester) Ltd.
Trafford Park, MANCHESTER, 17

A.I.D. APPROVED
Rubbaglex
(Regd.) Patent No. 519567

Rubbaglex Sheeting is processed on 100% pure glass cloth, has very high tensile strength, is rot proof and combines flexibility and resiliency with non-stretching properties.

Impervious to Aromatic Hydro Carbons. Highly recommended for Gaskets, Washers, Jointings, Diaphragms, Sleevings, also Floating Roof Tank Seals, etc.

RUBBAGLAS LTD.
ABFORD HOUSE
15 WILTON RD.
LONDON S.W.1
VICTORIA 6501

PLANNING FOR THE FUTURE

Our expanding programme of work on both civil and military aircraft requires us to increase the scope and size of our FUTURE PROJECTS DEPARTMENT.

Opportunities exist, for a number of first-class men with imagination and creative ability to join the team who are engaged in the solution of the intriguing problems of the next generation of aircraft, in the following categories:—

1. Performance Engineers
2. Stability and Control Specialists
3. Propulsion Engineers
4. Structural Engineers
5. Design Engineers

Successful applicants will be encouraged to broaden their scope, and facilities are available for further education in specialised subjects. All these positions carry good salaries and prospects of promotion. Monthly staff status will be offered at commencement to the more experienced men.

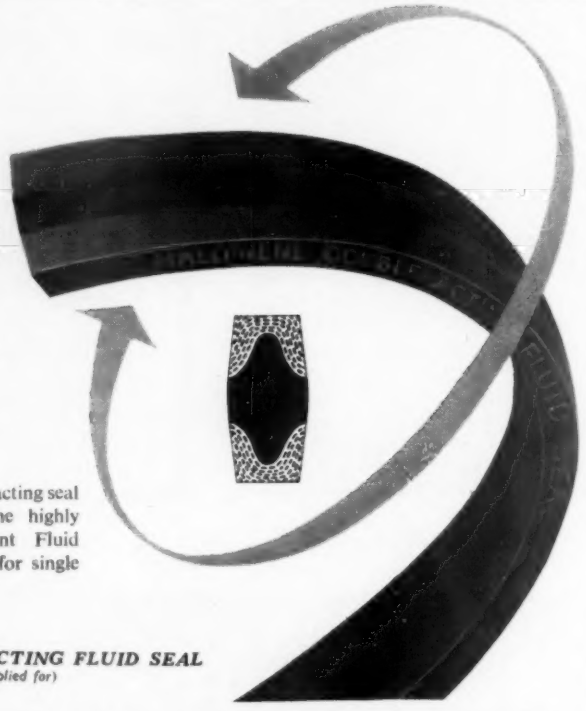
Please write giving particulars and quoting reference No. 16 to :—

The Personnel Manager
The de Havilland Aircraft Co. Ltd., Hatfield, Herts.
Member Company of the Hawker Siddeley Group.

at last . . .

an effective one piece double acting seal

Specially designed for double acting cylinders—the new "Hallprene" Patent Double Acting Fluid Seal.



★ Improves sealing
★ Prevents the possible formation of fluid traps
★ Reduces costs
★ Simplifies piston design
★ One seal replaces two

The new "Hallprene" double acting seal has been developed from the highly successful "Hallprene" Patent Fluid Seal—the most efficient seal for single acting applications.

Hallprene *PATENT DOUBLE ACTING FLUID SEAL*
(Patent applied for)

In Scotland:-
WILSON PLACE, EAST KILBRIDE, GLASGOW
Tel.: East Kilbride 20581

HALL & HALL LTD
Oldfield Works, Hampton, Middlesex *Telephone: Molesey 2180*

P.4095

INDEX TO ADVERTISERS

Name	Page
A	
Adcola Products, Ltd.	12
Aero-Enterprises (Boreham Wood), Ltd.	10
Associated Electrical Industries, Ltd.	13
B	
Bendix International: Division of Bendix Aviation Corporation	Inside Back Cover
Blackburn Engines, Ltd.	8
Bristol Siddeley Engines, Ltd.	9
British Institute of Engineering Technology	12
B.S.T. Aeronautical Co., Ltd.	12
C	
Cellon, Ltd.	1
Cental Office of Information, R.A.F. Recruiting	6, 7
Cross Manufacturing Co. (1938), Ltd.	12, 13
D	
Decca Radar Ltd.	Back Cover
De Havilland Aircraft Co., Ltd., The	13
H	
Hall & Hall, Ltd.	14
Hawker Siddeley Aviation, Ltd.	4
K	
Keegan Aviation, Ltd.	11
M	
Martin-Baker Aircraft Co., Ltd.	3
P	
Plessey Co. Ltd., The	Inside Front Cover
R	
Rolls-Royce, Ltd.	Front Cover
Rubbaglas, Ltd.	13
Rye, Claude, Bearings	12
S	
Sangamo Weston, Ltd.	2
Shackleton, W. S. (Aviation), Ltd.	10
V	
Vigors Aviation, Ltd.	10
W	
Westland Aircraft Ltd.	5

EDITORIAL AND BUSINESS NOTICES

"THE AEROPLANE and ASTRONAUTICS" is published every Friday in London, England, by TEMPLE PRESS LIMITED and is registered at the G.P.O. as a newspaper. Second class postage paid at New York, N.Y.

HEAD OFFICES: Bowling Green Lane, London, E.C.1, England. Telephone: Terminus 3636. Telegrams: "Pressimus, London, Telex." Telex: 23859.

BRANCH OFFICES: Bayliss House, Hurst Street, Birmingham, 5. Telephone: Midland 6616. 50 Hertford Street, Coventry. Telephone: Coventry 27414. 1 Brazennose Street, Manchester. Telephone: Deansgate 6114-8. 12 Renfield Street, Glasgow. Telephone: Glasgow Central 1413.

EDITORIAL: All editorial communications and matter must be addressed to the editor and not to individuals. Drawings and MSS, or other material not considered suitable will be returned if stamps are enclosed, but the editor does not hold himself responsible for the safe keeping or safe return of anything submitted for his consideration. Payment for contributions will be made following publication.

ADVERTISEMENTS.—Whilst every precaution is taken to ensure accurate printing, the publishers will not be responsible for printers' errors or for errors arising out of telephonic instructions relating to advertisement copy nor will they be responsible for advertisement blocks destroyed by fire or that are left in their possession for more than one year. Advertisers must in all cases bear the cost of drawings, photographs and/or blocks used in their advertisements. Copy must be supplied without application from the publishers, and current copy and blocks will be repeated if new copy is not received at the time of closing for press. Orders for advertisements are subject to acceptance in writing from the Head Offices. Advertisement copy is subject to the approval of the publishers. All advertisements and contracts are accepted and made upon the express condition that the publishers have the absolute right to refuse to insert any advertisement without stating a reason, including the right of rejection of advertisements, whole or part, containing cut prices of goods coming under an approved price-maintenance scheme, and such refusal shall not be a good ground for advertisers to stop a current contract or refuse to pay for the same or for taking action for breach of contract. The advertisers will indemnify the publishers against any damage sustained by them as a result of the inclusion of their advertisements. The publishers, whilst endeavouring to ensure that advertisements shall appear with all possible regularity, will not be held liable for any loss occasioned by failure of any advertisement to appear from any cause whatever. The acceptance of an order does not confer the right to renew on similar terms. The publishers reserve the right to increase the advertisement rates at any time, or to vary the terms of contract as regards space or frequency of insertion. All orders are accepted on the understanding that any such increase in rate or other amendment may come into immediate operation on all outstanding insertions. In such event, the advertiser has the option of cancelling the balance of contract. Contracts relate to the advertisers' own goods or services, and the space may not be sub-let or disposed of in any way. Conditions which are contained in order forms other than those of the Proprietors and which do not conform to or are in addition to the Proprietors' conditions will not be recognized as binding. Special conditions must be subject to mutual agreement.

SUBSCRIPTIONS AND SUPPLIES.—"The Aeroplane and Astronautics" is obtainable from newsagents and bookstalls or by post from the publishers at an annual subscription rate of £4 15 0 for the United Kingdom, £5 Overseas and $15.00 for Canada and U.S.A., postage included. Shorter periods pro rata. "The Aeroplane and Astronautics" is obtainable from newsagents and bookstalls abroad through the following Agents:—EUROPE—Messageries Dawson (S.A.), Paris; Messageries Hachette et Cie., Paris; W. H. Smith & Son, Paris and Brussels. CANADA—Wm. Dawson Subscription Service Ltd., Toronto; Gordon & Gotch, Ltd., Toronto. U.S.A.—Eastern News Co., 306 West 11th St., New York 14, N.Y. AFRICA—Central News Agency, Ltd., Cape Town; W. Dawson & Son (S.A.), Cape Town. ASIA—W. Thacker & Co., Ltd., P.O. 190 Bombay. AUSTRALIA and NEW ZEALAND—Gordon & Gotch (A'sia), Ltd.

DEPOSIT SYSTEM.—Commission 1 per cent. (minimum 2/-) on amount deposited: full details on application.

REMITTANCES.—Postal Orders, Cheques, etc., should be made payable to TEMPLE PRESS LIMITED.

COMMUNICATIONS.—All orders, letters and inquiries regarding advertisements, subscriptions, the Deposit System and other business matters should be addressed to the Manager, "The Aeroplane and Astronautics," Bowling Green Lane, London, E.C.1.

Printed in England and Published Weekly by the Proprietors, TEMPLE PRESS LIMITED, BOWLING GREEN LANE, LONDON, E.C.1.
Registered at the G.P.O. as a Newspaper. Second class postage paid at New York, N.Y. Registered for transmission to Canada and Newfoundland by magazine post. Annual Subscription Rate United Kingdom 95/-, other countries 100/- (Canada and U.S.A. $15) postage included. Shorter periods pro rata. AGENTS ABROAD—EUROPE—Messageries Dawson (S.A.), Paris; Messageries Hachette, et Cie., Paris; W. H. Smith & Son, Paris and Brussels. CANADA—Wm. Dawson Subscription Service, Ltd., Toronto; Gordon & Gotch, Ltd., Toronto. U.S.A.—Eastern News Co., 306 West 11th Street, New York, 14, N.Y. AFRICA—Central News Agency, Ltd., Cape Town; Wm. Dawson & Son (S.A.), Cape Town. ASIA—W. Thacker & Co., Ltd., P.O. 190, Bombay. AUSTRALIA and NEW ZEALAND—Gordon & Gotch (A'sia), Ltd.

Around the World

Bendix PROVIDES RELIABILITY

Because Bendix always anticipates aviation's next advance, almost every plane that flies relies in some way on Bendix creative engineering and reliability.

IN COMMUNICATIONS Bendix*VHF Radio Transmitters and Receivers • Interphone Systems • Audio Control Panels • Passenger Address Systems • Amspeakers* • Antennas • RF Power and VSWR Instruments

IN NAVIGATION Bendix Weather Radar • Doppler Navigation Systems • Helicopter Radar • Dead-reckoning Navigation Systems • Self-contained Integrated Navigation Systems for Military and Commercial Aircraft • Automatic Radio Compass Systems • Marker Beacon Receivers • VHF Omni-Range Equipment • VHF Ground Direction Finders • Glidescope Receivers • Microwave Equipment • Automatic Direction Finder Systems • Indicators • Automatic Pilot Systems • Central Air Data Computers • Polar Path* Compass • Supersonic Flight Control Systems

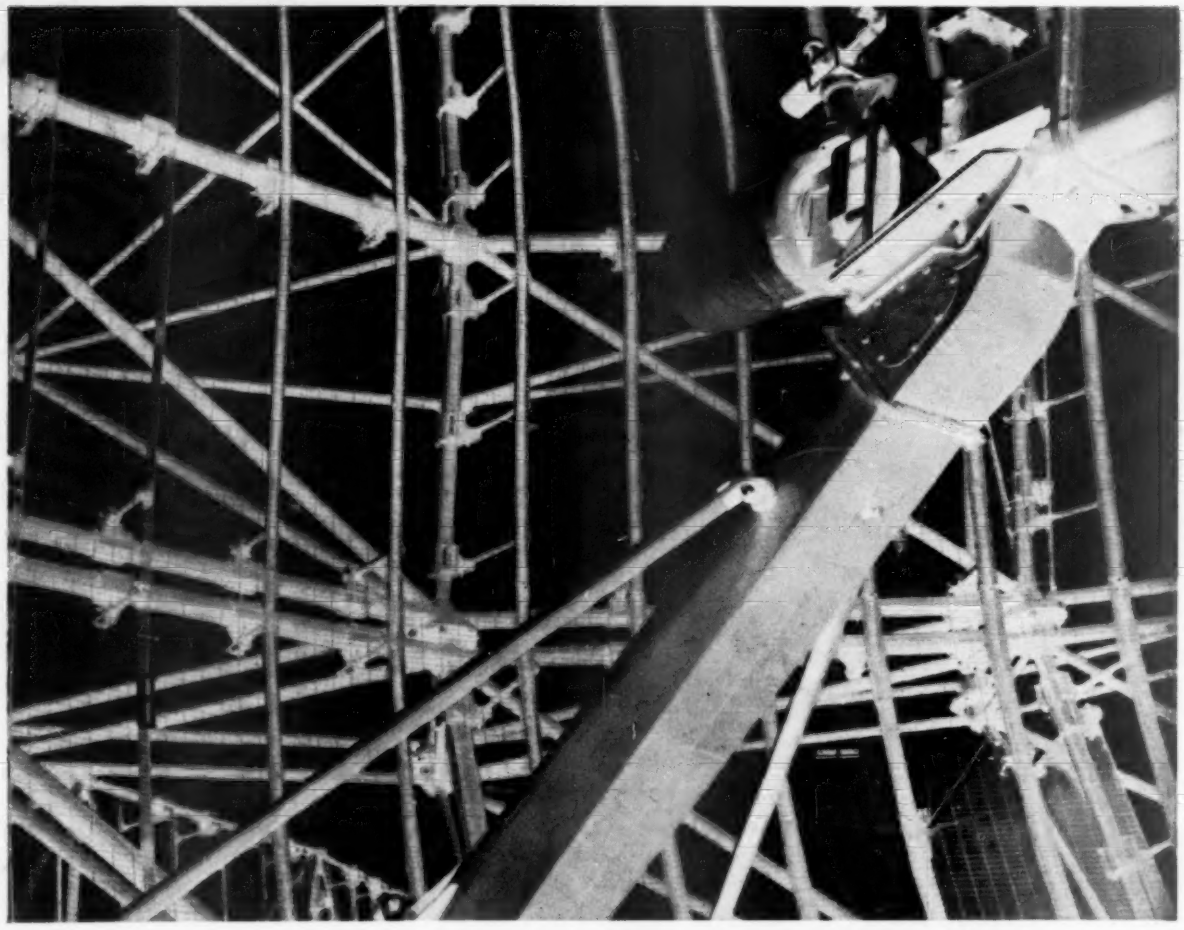
IN ENGINE COMPONENTS Bendix Direct Injection Fuel Systems • Fuel Metering Systems • Jet Engine Analyzers for Temperature and Vibration • Carburetors • Fuel-Flow Totalizing Systems • Engine Starting Equipment • Magnetos • Ignition Analyzers • Ignition Systems • Electrical Connectors • Generators

IN AIRFRAME PARTS Bendix Hydraulic Actuating Equipment • Shock-absorbing Struts • Hydraulic Master Cylinders • Landing Gear—Wheels • Cerametalix* Brake Lining • Power Brake Valves • Rotor Type Brakes • De-Icer Systems • Anti-Skid Devices • Oxygen Systems

*REGISTERED TRADEMARK

Bendix International DIVISION THE Bendix CORPORATION

205 E. 42ND ST., NEW YORK 17, N. Y., U.S.A. CABLE ADDRESS: "BENDIXINT, N. Y."



DECCA RADAR IN DEFENCE

To a greater extent than ever before, defence is today a matter of anticipation. The efficacy of different counter-measures is directly related to the accuracy and scope of warning equipment.

This is especially true at the strategical level where massive Decca-built long range radars are constantly ready to set in motion the weapons of interception.

Behind this primary line of protection, however, there are many calls for radars of a like reliability for specialised functions; these equipments, too, Decca design and manufacture, from the very large but transportable installations through the whole range of military radars to the compact equipments that are fitted into aircraft.

Every one of this great series, advanced in conception, low in capital and operating costs and dependable in service, has a distinct and essential contribution to make to defence systems, in which no link can be anything but of the strongest.

DECCA RADAR DECCA RADAR LIMITED · LONDON · ENGLAND

DR 144